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LUBRICITY AND DERIVED CETANE NUMBER MEASUREMENTS OF JET FUELS, ALTERNATIVE FUELS AND FUEL BLENDS

INTERIM REPORT
TFLRF No. 405

by
Nigil Jeyashekar, Ph.D., P.E.[1], Patsy Muzzell[2], Eric Sattler[2], and Nichole Hubble[2]

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Southwest Research Institute® (SwRI®)
San Antonio, TX

for
[2]U.S. Army TARDEC
Force Projection Technologies
Warren, Michigan

Contract No. DAAE-07-99-C-L053 (WD23)

Approved for public release: distribution unlimited

July 2010

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SwRI® Project No. 08.03227.23.111 and 08.03227.23.112

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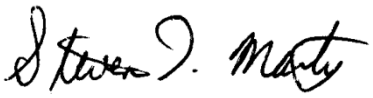

Steven D. Marty, P.E., Director
U.S. Army TARDEC Fuels and Lubricants Research Facility (SwRI®)

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
23-07-2010	Final Interim Report	June 1999 – August 2010

4. TITLE AND SUBTITLE
Lubricity and Derived Cetane Number Measurements of Jet Fuels, Alternative Fuels and Fuel Blends

5a. CONTRACT NUMBER
DAAE07-99-C-L053

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Jeyashekar, Nigil; Muzzell, Patsy; Sattler, Eric; Hubble, Nichole

5d. PROJECT NUMBER
SwRI 08.03227.23.111; 08.03227.23.112

5e. TASK NUMBER
WD 23

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army TARDEC Fuels and Lubricants Research Facility (SwRI®)
Southwest Research Institute®
P.O. Drawer 28510
San Antonio, TX 78228-0510

8. PERFORMING ORGANIZATION REPORT NUMBER
TFLRF No. 405

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army RDECOM
U.S. Army TARDEC
Force Projection Technologies
Warren, MI 48397-5000

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The objectives are to perform bench top lubricity tests and measure cetane ratings on a given set of fuels and fuel blends per ASTM standards. Overall results indicate that the dilution of the synthetic fuel, by 50%, with petroleum fuel, results in the improvement of lubricity of the synthetic fuel to the level of petroleum fuel. Cetane ratings were measured by Cetane Index, Cetane Number and Derived Cetane Number (DCN). It was concluded that in general, blends with a higher ratio of a component with a high cetane rating will have an overall higher cetane rating and that blends with a higher ratio of a component with low cetane rating will have an overall lower cetane rating. It was concluded that the DCN results from two different sources have approximately 95% correlation.

15. SUBJECT TERMS
Lubricity, Derived Cetane Number, Jet Fuel, Cetane Index, Ignition Quality Test (IQT)

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			19b. TELEPHONE NUMBER *(include area code)*
Unclassified	Unclassified	Unclassified	Unclassified	61	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

EXECUTIVE SUMMARY

The interim report summarizes Tasks XIII (fuel lubricity) and XIV (fuel cetane ratings) of Work Directive 23. The objective of Task XIII was to perform bench top lubricity tests on a given set of fuels and fuel blends per standard ASTM conditions. The base fuels chosen were Syntroleum S-8, Jet A, JP-8, SASOL GTL and No. 2DS15. BOCLE (ASTM D5001), HFRR (ASTM D6078) and SLBOCLE (ASTM D6079) tests were used to measure lubricity of the base fuels and fuel blends prepared from these base fuels. The response of lubricity to maximum and minimum treat rates of two military-approved additives per QPL-25017, Nalco 5403 and DCI-4A (corrosion inhibitors/lubricity improvers) were analyzed. It was inferred, from BOCLE results, that the dilution of the synthetic fuel, by 50%, with petroleum fuel, results in the improvement of lubricity of the synthetic fuel to the level of petroleum fuel. It was also concluded that HFRR method is not capable of differentiating untreated and treated fuel, whether synthetic or petroleum, with the addition of the military approved additives. There is a trend of higher SLBOCLE values with addition of additives. Since all these values are within the repeatability of the test method, in essence there is no trend as the differences among these values are considered to be insignificant/not repeatable.

The objective of Task XIV of Work Directive 23 is to study the ignition and combustion characteristics by determining Cetane Index, Cetane Number and Derived Cetane Number (DCN) for a given set of fuels and fuel blends. The base fuels used for this task are EPA certified ULSD #2, Syntroleum S-8, JP-8, SASOL GTL, and biodiesel. Cetane Index was calculated per ASTM D976 and ASTM D4737. Cetane Number was measured using ASTM D613-05 and Derived Cetane Number was determined using the Ignition Quality Tester (IQT) per ASTM D6890-7a at Southwest Research Institute (SwRI) and at Wayne State University (WSU). It was concluded that in general, the cetane ratings (Cetane Number or DCN) of fuel blends were either higher or lower than the base petroleum fuel in the blend as influenced by the cetane ratings of the synthetic, biodiesel, and/or cetane improver component in the blend. It was determined that IQT DCN data from SwRI and WSU had a correlation value of 95.28%. However, the population means and variances do not have a high degree of similarity from *t*-Test and *F*-test at 95% and 99% confidence limits.

FOREWORD/ACKNOWLEDGMENTS

The U.S. Army TARDEC Fuel and Lubricants Research Facility (TFLRF) located at Southwest Research Institute (SwRI), San Antonio, Texas, performed this work during the period January 2007 through May 2010 under Contract No. DAAE-07-99-C-L053. The U.S. Army Tank Automotive RD&E Center, Force Projection Technologies, Warren, Michigan administered the project. Mr. Luis Villahermosa (AMSRD-TAR-D/MS110) served as the TARDEC contracting officer's technical representative. Ms. Pat Muzzell and Mr. Eric Sattler of the U.S. Army National Automotive Center served as project technical monitors.

The author would like to acknowledge the contribution of the TFLRF technical support staff along with the administrative and report-processing support provided by Dianna Barrera.

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ACRONYMS AND ABBREVIATIONS

μm	Micrometer
API	American Petroleum Institute
ASTM	American Society for Testing Materials
BioD	Biodiesel
BOCLE	Ball-On Cylinder Lubricity Evaluator
CI/LI	Corrosion Inhibitor/Lubricity Improver
DCI	DuPont Corrosion Inhibitor
DCN	Derived Cetane Number
EPA	Environmental Protection Agency
g	Grams
GTL	Gas To Liquid
HFRR	High Frequency Reciprocating Test Rig
IQT	Ignition Quality Test
JP-8	Jet Propulsion Fuel 8
mm	Millimeter
QPL	Qualified Product Listing
SASOL	*Suid Afrikaanse Steenkool en Olie* (Afrikaans for *South African Coal and Oil*)
SLBOCLE	Scuffing Load Ball-On Cylinder Lubricity Evaluator
SWRI®	Southwest Research Institute®
TARDEC	Tank Automotive Research, Development and Engineering Center
ULSD	Ultra Low Sulfur Diesel
WSU	Wayne State University

1.0 FUEL LUBRICITY MEASUREMENTS – TASK XIII OF WD23

1.1 OBJECTIVE

The objective was to perform bench-top lubricity tests on a given set of fuels and fuel blends per standard ASTM test methods.

1.2 FUELS, FUEL BLENDS AND TEST METHODS

a. The base fuels used for lubricity tests were:
   i. S-8 (AL-27074)
   ii. Jet A (AL-27557)
   iii. JP-8 (AL-27164)
   iv. SASOL GTL (AL-28157F)
   v. No. 2DS15 (AL-27613F)
b. The two Corrosion Inhibitors/Lubricity Improver (CI/LI) additives used were: Nalco 5403 (CI/LI #1) and DCI-4A (CI/LI #2).
c. The following fuel blends were prepared:
   i. Blend-1 containing 50% S-8 and 50% Jet A
   ii. Blend-2 containing 50% S-8 and 50% JP-8
d. The following ASTM test methods were used to perform bench-top lubricity tests:
   i. BOCLE – ASTM D5001
   ii. SLBOCLE – ASTM D6078
   iii. HFRR – ASTM D6079

1.3 DESCRIPTION

S-8, Jet A, Blend-1, JP-8, Blend-2, SASOL GTL, and No. 2DS15 were the fuel samples used for lubricity tests. S-8, Jet A, Blend-1 and Blend-2 were treated with the CI/LI chemicals at their corresponding maximum and minimum treat rates as prescribed by QPL-25017-22. The treated fuel samples were used for lubricity tests. Three neat fuel samples of JP-8, SASOL GTL and No.

2DS15 without the CI/LI additives were used for lubricity tests. HFRR (ASTM D6079), BOCLE (ASTM D5001) and SLBOCLE (ASTM D6078) tests were performed on all the twenty-three fuel samples and the results are listed in Tables 1-7.

1.4 TEST RESULTS

The lubricity test results for all the fuels and fuel blends are listed in Tables 1-7.

Table 1. S-8

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	S-8	1.01	559	950
2	S-8 + CI/LI #1: 12 mg/L	0.75	754	1300
3	S-8 + CI/LI #1: 22.5 mg/L	0.54	783	1500
4	S-8 + CI/LI #2: 9 mg/L	0.65	758	1100
5	S-8 + CI/LI #2: 22.5 mg/L	0.56	819	1600

Table 2. Jet A

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	Jet A	0.67	674	1250
2	Jet A + CI/LI #1: 12 mg/L	0.58	669	1250
3	Jet A + CI/LI #1: 22.5 mg/L	0.54	697	1550
4	Jet A + CI/LI #2: 9 mg/L	0.56	652	1600
5	Jet A + CI/LI #2: 22.5 mg/L	0.55	696	1450

Table 3. Blend-1: 50% S-8 and 50% Jet A

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	Blend-1	0.68	689	1250
2	Blend-1 + CI/LI #1: 12 mg/L	0.63	700	1350
3	Blend-1 + CI/LI #1: 22.5 mg/L	0.58	665	1500
4	Blend-1 + CI/LI #2: 9 mg/L	0.55	692	1900
5	Blend-1 + CI/LI #2: 22.5 mg/L	0.61	672	2100

Table 4. JP-8

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	JP-8	0.48	720	1450

Table 5. Blend-2: 50% S-8 and 50% JP-8

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	Blend-2	0.49	699	1650
2	Blend-2 + CI/LI #1: 6 mg/L	0.48	665	1950
3	Blend-2 + CI/LI #1: 11.25 mg/L	0.48	685	2000
4	Blend-2 + CI/LI #2: 4.5 mg/L	0.49	749	1800
5	Blend-2 + CI/LI #2: 11.25 mg/L	0.50	668	2000

Table 6. SASOL GTL

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	SASOL GTL	0.48	635	2050

Table 7. No. 2DS15

S.No.	Fuel	BOCLE (mm)	HFRR (µm)	SLBOCLE (g)
1	No. 2DS15	0.67	557	>4000

1.5 BOCLE TEST RESULTS AND ANALYSIS

The general trend in BOCLE wear scar is that the value decreases with increase in additive concentration for both Nalco 5403 and DCI-4A as shown in Figures 1a, 1b, 1c and 1d. For S-8 response (Fig. 1a), the BOCLE wear scar decreases significantly (>0.08 mm which is repeatability value) at both treat rates, and for both additives. For Jet A response (Fig. 1b), BOCLE decreases significantly at low treat rates for both additives, but not for either additive from low treat rate to high treat rate. For Blend-1 (Fig. 1c), consisting of 50% S-8 and 50% Jet A, BOCLE does not decrease significantly for CI/LI #1 from untreated fuel to low treat rate or from low treat rate to high treat rate. However, the decrease is significant, although just barely (0.10 mm difference), from the untreated fuel to the high treat rate.

The untreated Jet A had a BOCLE of 0.67 mm, untreated S-8 had a BOCLE of 1.01 mm, and the untreated blend of these fuels was measured to have a BOCLE of 0.68 mm. This indicates the dominance of the lubricity for the blend from the inherent lubricity of the Jet A (petroleum) fuel. For Blend-2 response (Fig. 1d), BOCLE does not change significantly for either additive or in going from the untreated fuel to low treat rate or the high treat rate. In looking at the BOCLE for untreated JP-8 of 0.48 mm and then for Blend-2 of 0.49 mm, this appears to once again show the dominance of the lubricity from the petroleum fuel when it is blended with a synthetic fuel which had a BOCLE of 1.01 mm. It can be inferred from BOCLE results that the dilution of the synthetic fuel, by 50%, with petroleum fuel, results in the improvement of lubricity of the synthetic fuel to the level of petroleum fuel.

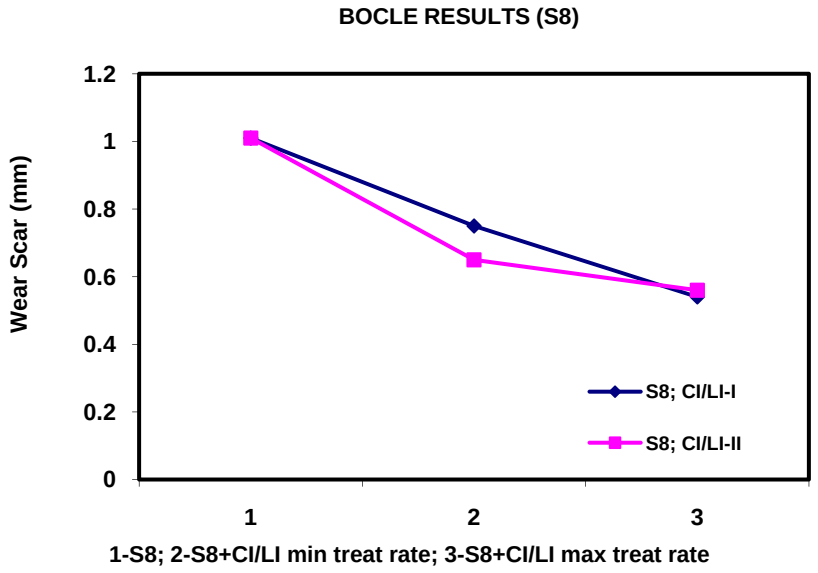

Figure 1a: Change in wear scar for S-8 with different additives and treat rates (BOCLE)

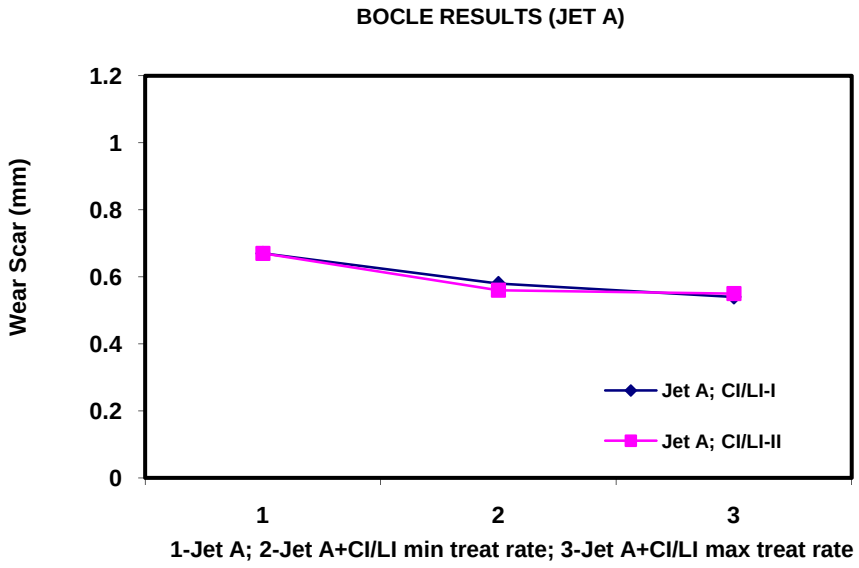

Figure 1b. Change in wear scar for Jet A with different additives and treat rates (BOCLE)

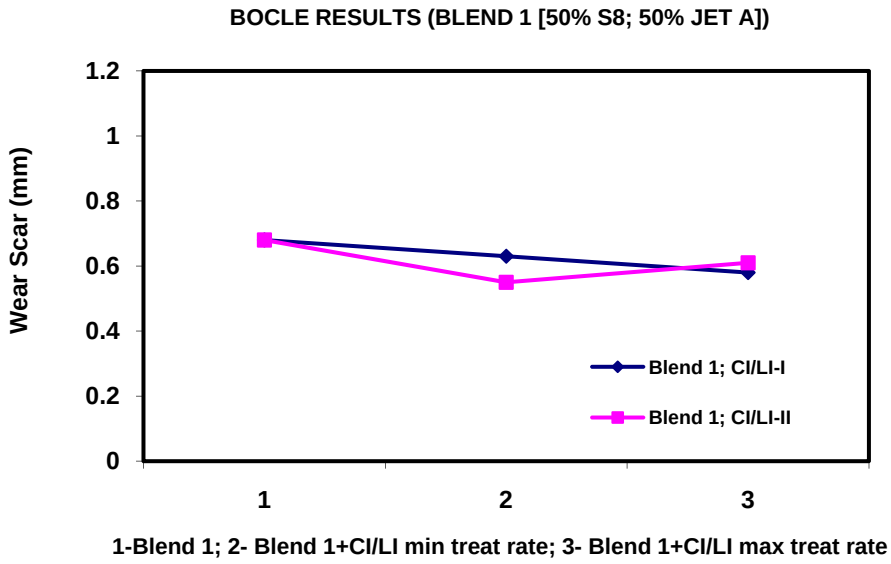

Figure 1c. Change in wear scar for Blend-1 with different additives and treat rates (BOCLE)

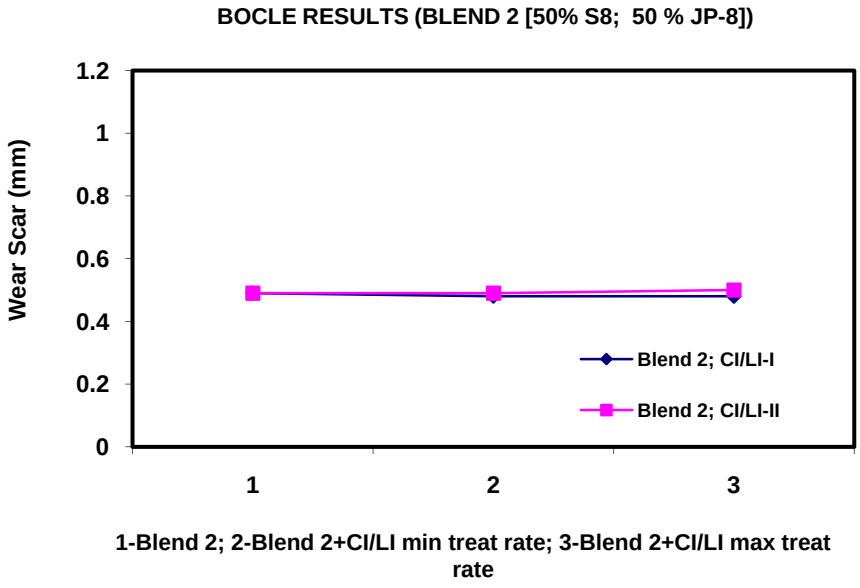

Figure 1d. Change in wear scar for Blend-2 with different additives and treat rates (BOCLE)

1.6 HFRR TEST RESULTS AND ANALYSIS

The analysis of HFRR data begins by examining the significance of the test results. This judgment is made based on the repeatability of the HFRR test method which is 80 µm. The data bears the following facts:

- For the S-8 fuel, there is a significant response, for both additives, from the untreated S-8 to the S-8 at the low treat rate or S-8 at the high treat rate as shown in Figure 2a. However, there is no significant response from the low treat rate to the high treat rate for both additives. However, the response is the opposite of what is expected because the wear scar actually increases with the addition of additive.
- For the Jet A, there is no significant response for either additive or for any change from untreated to treated fuels as shown in Figure 2b.
- For Blend-1 and Blend-2, there is no significant response for either additive or for any change from untreated to treated fuels. The response for Blend-1 and Blend-2 to additives are shown in Figure 2c and 2d.
- In reviewing the HFRR results for the S-8, Jet A, and JP-8 which are 559 µm, 674 µm, and 720 µm, respectively, it is interesting to note that the S-8 has a significantly lower HFRR than for either the Jet A or JP-8. This result is contrary to what would be expected, since the synthetic fuel should have poorer lubricity and thus a higher HFRR than a petroleum fuel.

Based on the above facts on the HFRR test, the following conclusions can be drawn:

- HFRR test method does not respond to the addition of Nalco 5403 and DCI-4A (corrosion inhibitor/lubricity improver additives) at the prescribed QPL treat rates for Jet A, Blend-1 and Blend-2.
- There is no reasonable explanation to account for the low value of wear scar observed in HFRR for neat S-8, the increasing trend with the addition of CI/LI additives, and the fact that petroleum fuel has poorer lubricity than synthetic fuel.
- For all the fuels and for both additives, that the HFRR method is not capable of differentiating untreated and treated jet fuels, whether synthetic or petroleum, with the addition of military-approved additives from the QPL at the relatively low treat rates that are allowed for this additive in jet fuel used by the military.

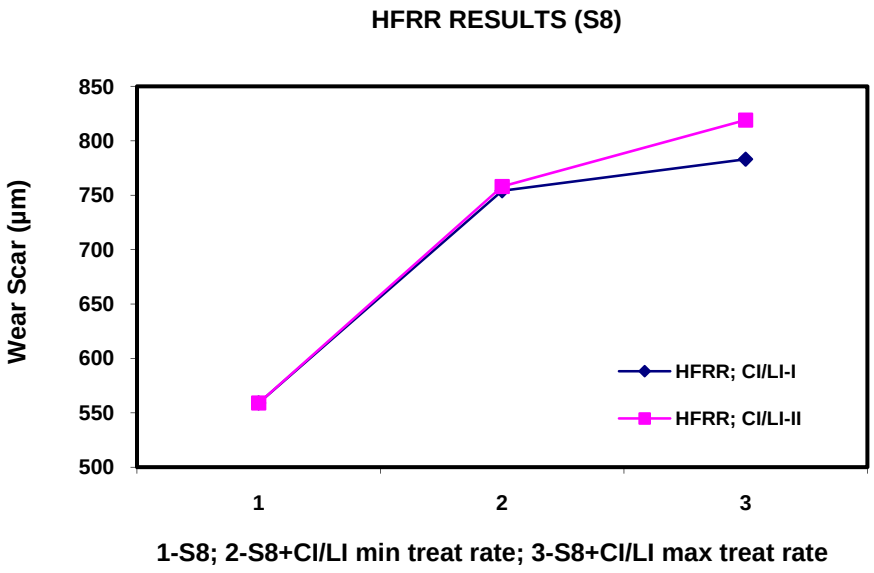

Figure 2a. Change in wear scar for S-8 with different additives and treat rates (HFRR)

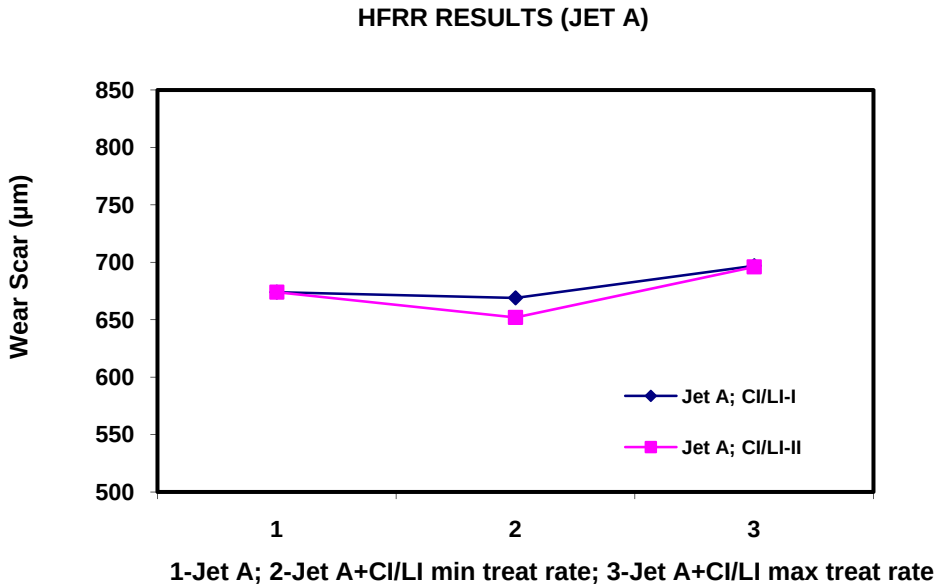

Figure 2b. Change in wear scar for Jet A with different additives and treat rates (HFRR)

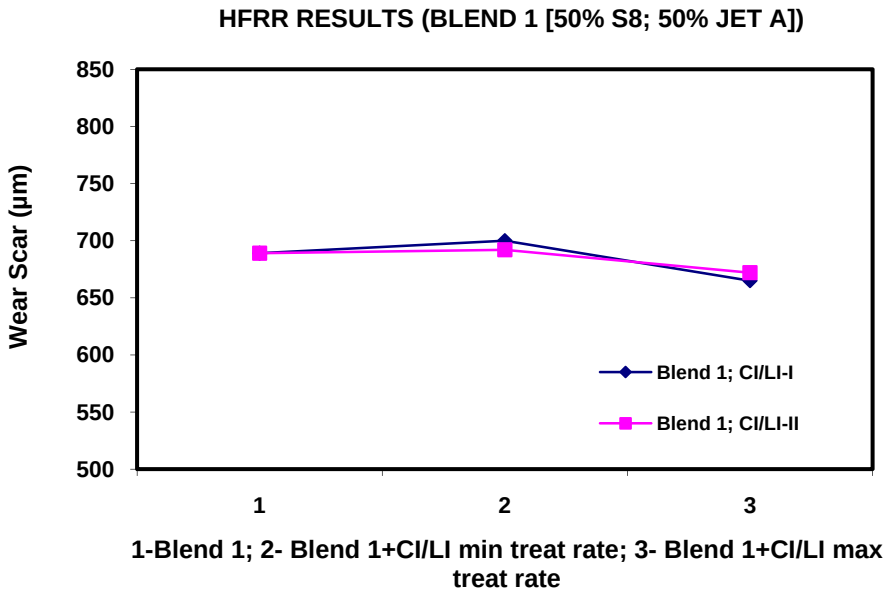

Figure 2c. Change in wear scar for Blend-1 with different additives and treat rates (HFRR)

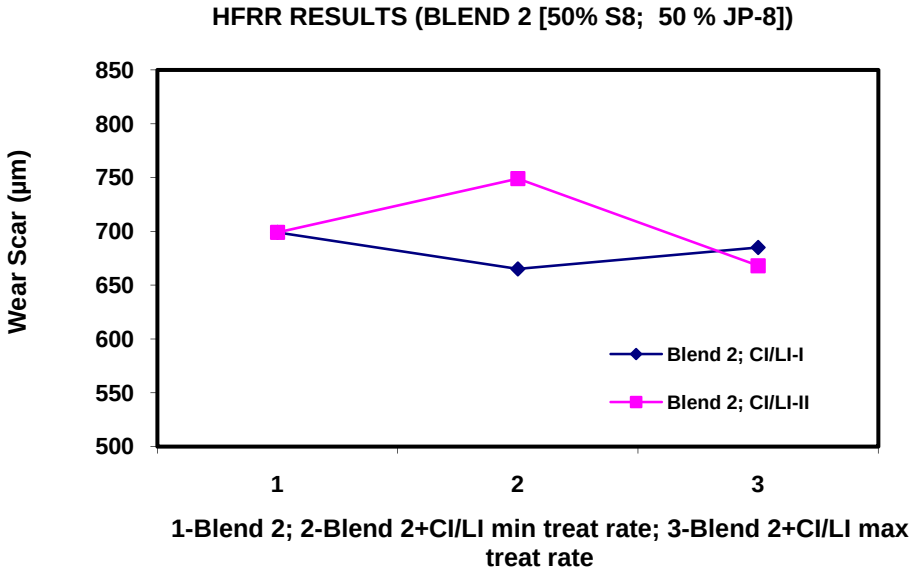

Figure 2d: Change in wear scar for Blend-2 with different additives and treat rates (HFRR)

1.7 SLBOCLE TEST RESULTS AND ANALYSIS

The change in applied load (grams), with Nalco 5403 and DCI-4A additives, at maximum and minimum treat rates for S-8, Jet A, Blend-1 and Blend-2 for the SLBOCLE test are shown in Figures 3a, 3b, 3c, 3d. SLBOCLE applied load increases with increasing concentrations of both additives in S-8. The increase in applied load with increasing additive concentration holds good for the Jet A treated with Nalco 5403 (Figure 3b). However, the applied load decreases from 1600 g to 1450 g when DCI-4A concentration is increased from minimum treat rate of 9 mg/L to the maximum treat rate of 22.5 mg/L for Jet A. Since this decrease is well within the repeatability of the test method, for all practical purposes the applied load profile (for Jet-A with DCI-4A additive) can be considered to be a constant at both the additive concentrations. So, even though there is a "trend" of higher SLBOCLE values with addition of additives, since all these values are within the repeatability of the test method, in essence there is no trend as the differences among these values are considered to be insignificant (not repeatable). It should be noted that all values, with the exception of the BOCLE and HFRR for the S-8 samples, are within the repeatability of the test methods and can be considered constant.

1.8 REPEATABILITY AND REPRODUCIBILITY AS DEFINED BY ASTM

Repeatability is defined as the difference between successive test results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, and in the normal and correct operation of the test method exceed the values in the table in only one case in twenty. Reproducibility is defined as the difference between two single and independent results, obtained by different operators working in different laboratories on identical test material would, in the long run, and in the normal and correct operation of the test method exceed the values in the table in only one case in twenty. The repeatability and reproducibility values of lubricity tests are listed below:

Table 8. Repeatability and Reproducibility of ASTM Lubricity Tests

Test Method	Repeatability	Reproducibility
ASTM D 5001 (BOCLE) (semi-automatic)	0.08311 mm	0.1178 mm
ASTM D 6078 (SLBOCLE)	900 g	1500 g
ASTM D 6079 (HFRR) at 60^{o}C	80 µm	136 µm

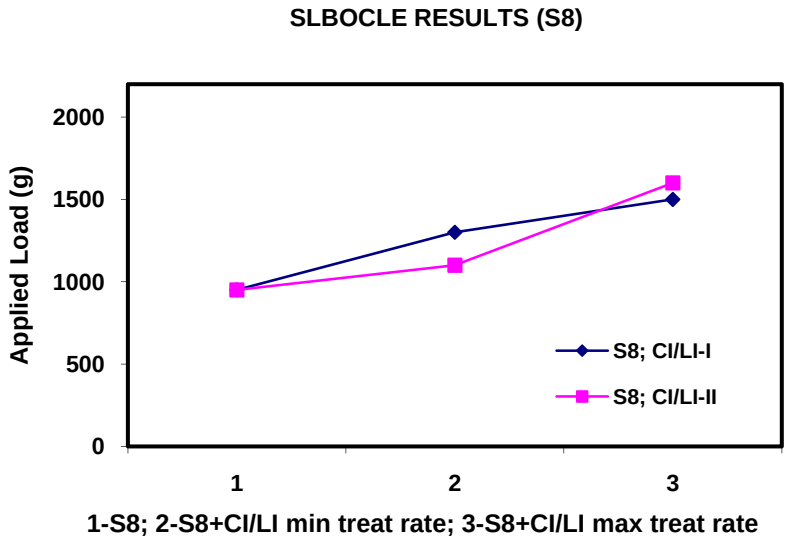

Figure 3a. Change in applied load for S-8 with different additives and treat rates (SLBOCLE)

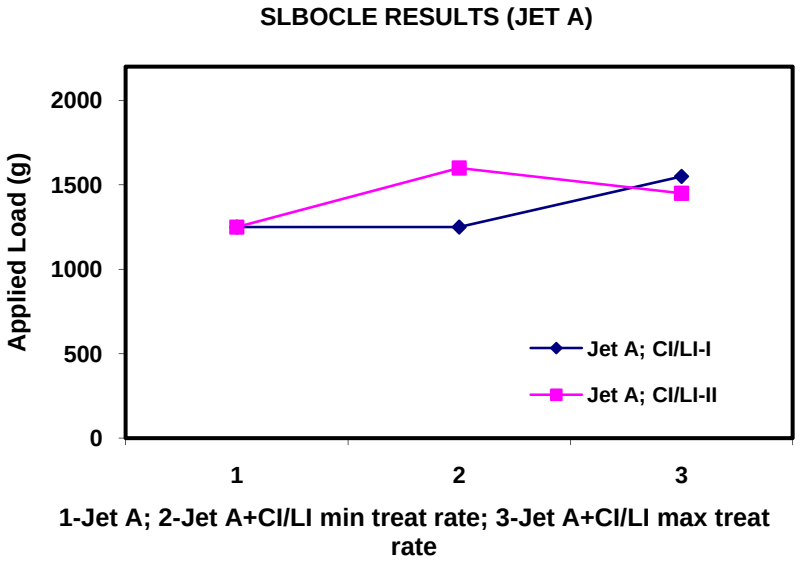

Figure 3b. Change in applied load for Jet A with different additives and treat rates (SLBOCLE)

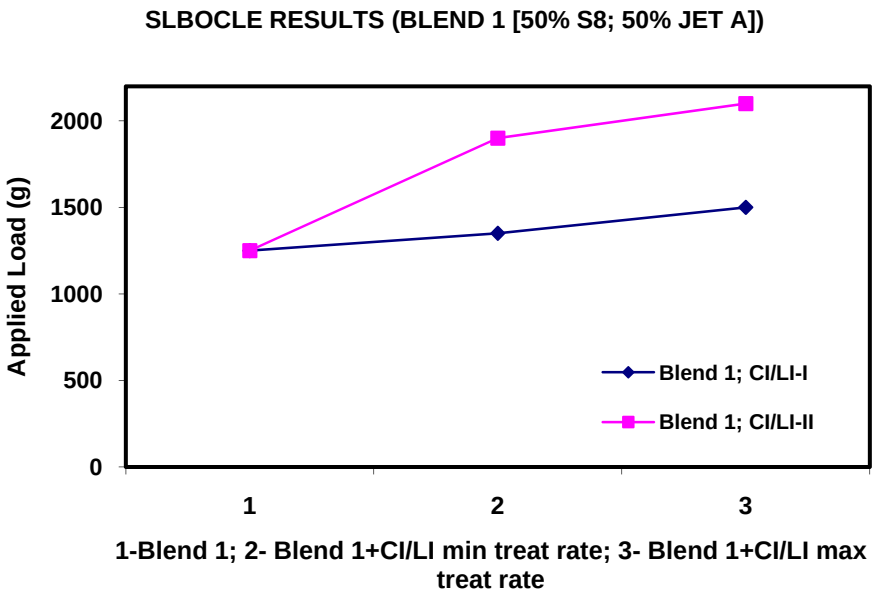

Figure 3c. Change in applied load for Blend-1 with different additives and treat rates (SLBOCLE)

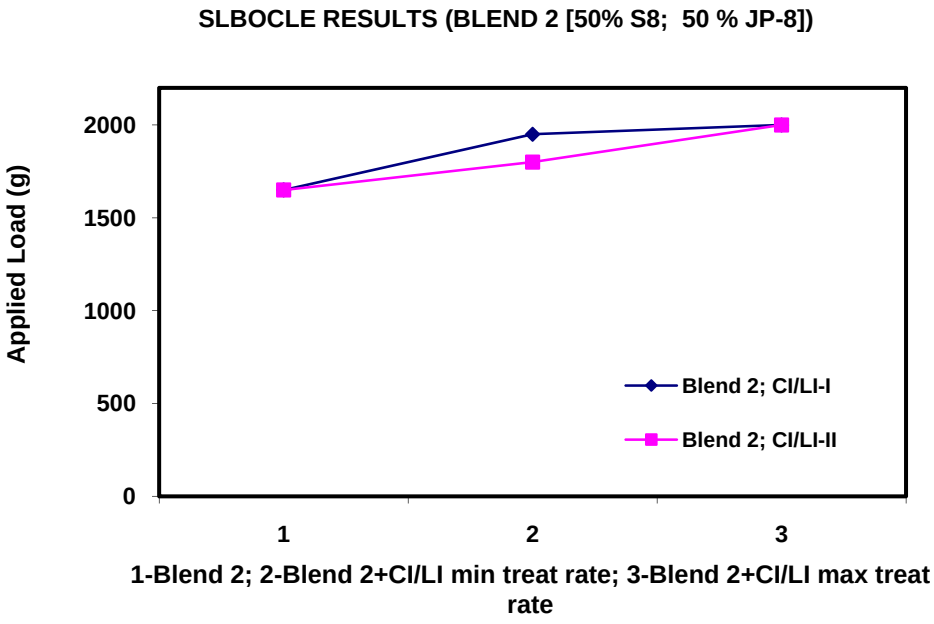

Figure 3d. Change in applied load for Blend-2 with different additives and treat rates (SLBOCLE)

2.0 DERIVED CETANE NUMBER – TASK XIV OF WD23

2.1 OBJECTIVE

The objective was to determine the Cetane Index and the Derived Cetane number for a given set of fuels and fuel blends per standard ASTM test methods.

2.2 FUELS, FUEL BLENDS AND TEST METHODS

a. The base fuels used for this task are: EPA Certified ULSD #2 (ULSD - AL 28197), Syntroleum S-8 (AL 27074), JP-8 (AL 27810), SASOL GTL (AL 28157F), biodiesel (BioD - AL 28129F). Biodiesel was obtained from Biodiesel Industries in Dallas, TX.
b. The additive used was pure 2-ethyl hexyl nitrate (a cetane improver). This chemical was obtained from Afton Chemicals for testing. The minimum and maximum treat rates were 0.135% and 0.27% by weight of the sample.
c. Twenty-two fuel blends were prepared with the addition of cetane improver to certain blends as per instructions from TARDEC. Cetane improvers were added at minimum and maximum treat rates as shown in Table 9.
d. The following tests were conducted for all the 22 samples:
    i. Cetane Index per ASTM D976 and ASTM D4737
    ii. Cetane Number per ASTM D613-05
    iii. Derived Cetane Number using IQT per ASTM D6890-7a at SwRI and Wayne State University.

2.3 EXPERIMENTS AND RESULTS

a. The following ASTM tests were performed and the results were recorded: ASTM D976, ASTM D4737, ASTM 613-05 and Derived Cetane Number using Ignition Quality Test (IQT DCN) per ASTM D6890-7a. The results are listed in Table 10.
b. IQT tests have been conducted for all the fuels and fuel blends at SwRI and WSU, an external site acceptable to TARDEC. The external testing was conducted at the National Biofuels Energy Laboratory, Next Energy, Wayne State University, 461 Burroughs, Detroit,

MI-48202. Dr. Simon Ng and Dr. Kapila Wadumesthrige were the points of contact at Wayne State University. The IQT test results are also included in Table 2.

c. All the test results are tabulated in Tables 9, 10, and 11. Table 9 lists the matrix of fuel volumes used for preparing fuel sample blends. Table 10 lists the results from all the ASTM tests. API gravity and specific gravity from ASTM D4052 and boiling points of fractions from ASTM D86 were used to compute Cetane Index for ASTM D4737 and D976. This additional data is reported in Table 11.

2.5 RESULT ANALYSIS

i. Cetane ratings were measured by all the ASTM methods for 22 fuel samples that included neat ULSD (CL 0092), S-8 (CL 0093), SASOL (CL 0094), BioD (CL 0095), and JP-8 (CL 0099) as well as blends prepared from the neat fuel samples. By comparing the results of all the test methods for the neat fuel samples it can be seen that SASOL had the highest cetane rating followed by S-8, BioD, ULSD and JP-8.

ii. The cetane improver used at minimum and maximum treat rates had little or no impact on cetane indices for ULSD (CL 0097 and CL 0098), JP-8 (CL 0103 and CL 0104) or the JP-8:BioD 4:1 blend (CL 0105 and CL 0106).

iii. The cetane indices of JP-8 (50%) blended with SASOL (50%) (CL 0102) and S-8 (50%) (CL 0100) shows an inconsistent increase as the base fuel JP-8 is compared with both the blends for both D4737 and D976 test methods. However, cetane ratings (D613-05 and D9890-7a) show a consistent increase for both fuel blends compared to JP-8.

iv. The Cetane Index equations were designed for regular petroleum diesel fuel and have been widely used for JP-8, since it also can be classified as a No. 1 petroleum diesel. S-8 and SASOL are synthetic fuels and the Cetane Index equations do not apply to these fuels and their blends. The distillation range for synthetic fuels are not as same as petroleum diesel fuels. This accounts for the inconsistencies in cetane indices of JP-8 fuel blends with SASOL and S-8. The inconsistencies could be observed in cetane indices of all fuel blend samples containing SASOL and S-8. This also applies to biodiesel as well as ULSD since the Cetane Index equations have not yet been modified to accommodate the properties of these fuels and their blends. ASTM is currently addressing this issue.

Overall, it can be concluded that D4737 and D976 cannot be used to evaluate cetane indices for JP-8 based synthetic fuel blends, biodiesel blends and ULSD blends.

v. The cetane improver used at minimum and maximum treat rates had an impact on cetane ratings, unlike cetane indices, for ULSD (CL 0097 and CL 0098), JP-8 (CL 0103 and CL 0104) and the JP-8:BioD 4:1 blend (CL 0105 and CL 0106).

vi. The cetane rating measured by D613-05 is based on test conducted in a cetane engine and D6890-7a is based on Ignition Quality Tester (IQT) that correlates results back to cetane engine to obtain Derived Cetane Number (DCN). The cetane ratings, unlike the cetane indices, are based on ignition delay in the engine and is irrespective of API specific gravity or distillation data of the fuel/fuel blend. Thus cetane ratings should be used to account for fuel blend combustion quality.

vii. When cetane ratings of 1:1 blends of JP-8 and SASOL (CL 0100) versus JP-8 and S-8 (CL 0102) were compared, the JP-8 and SASOL blend showed higher cetane ratings. When cetane ratings of 1:4 blends of BioD with JP-8 (CL 0101) verses BioD with ULSD (CL 0108) were compared, the BioD with ULSD blend exhibited higher cetane ratings.

viii. Three different blends were prepared with different ratios of S-8, JP-8 and SASOL (CL 0096, 0112 and 0113). The cetane rating was lowest for the S-8:JP-8:SASOL, 1:2:1 blend. The cetane ratings increase significantly for the S-8:JP-8:SASOL, 2:1:1 and 1:1:2 blends with the latter being marginally higher. Two different blends were prepared with different ratios of JP 8, SASOL and BioD (CL 0107 and 0110). The JP-8:SASOL:BioD, 8:1:1 blend had lower cetane ratings compared to the 2:2:1 blend.

ix. It can be concluded, in general, that blends with a higher ratio of a component with a high cetane rating will have an overall higher cetane rating. Blends with a higher ratio of a component with a low cetane rating will have an overall lower cetane rating. It can also be concluded that cetane ratings, for fuel blends containing synthetic fuels, biodiesel and ULSD, can be better predicted by Cetane Number (D613-05) and IQT DCN (D6890-7a) as opposed to Cetane Index equations by D4737 and D976.

Table 9. Matrix of fuel volumes used for preparing fuel blends

Blend No.	EPA Cert. ULSD #2 [AL-28197] (ml)	S-8 [AL-27810] (ml)	JP-8 [AL-27810] (ml)	SASOL GTL [AL-28157F] (ml)	Biodiesel (BioD) [AL-28129] (ml)	Cetane Improver [AL 28160F] (wt %)	Blend Vol. (ml)	Sample Code CL08-	Amount of CI added (g)
1	1700						1700	0092	
2		1700					1700	0093	
3			1700				1700	0099	
4				1700			1700	0094	
5					1700		1700	0095	
6		850	850				1700	0100	
7			850	850			1700	0102	
8		425	850	425			1700	0096	
9	1360				340		1700	0108	
10			1360		340		1700	0101	
11	1700					0.135 (min. tr.)	1700	0097	1.89
12	1700					0.270 (max. tr.)	1700	0098	3.78
13			1700			0.135 (min. tr.)	1700	0103	1.79
14			1700			0.270 (max. tr.)	1700	0104	3.56
15			1360		340	0.135 (min. tr.)	1700	0105	1.81
16			1360		340	0.270 (max. tr.)	1700	0106	3.64
17			1360	170	170		1700	0107	
18		170	1360		170		1700	0109	
19			680	680	340		1700	0110	
20		680	680		340		1700	0111	
21		425	425	850			1700	0112	
22		850	425	425			1700	0113	

Table 10. Cetane Index, Cetane Numbers and DCN from IQT Tests

Sample Code CL08-	Fuel Sample	ASTM Tests						
		Cetane Index D4737	Cetane Index D976	Cetane Number D613-05	D6890-7a IQT DCN			
					Mean		Standard Deviation	
					SwRI	WSU	SwRI	WSU
0092	EPA Certified ULSD	48.8	49.0	47.0	43.43	43.43	0.75	0.43
0093	S-8	71.4	65.9	58.1	60.20	56.46	0.99	1.37
0094	SASOL	82.2	76.2	74.8	79.92	71.78	1.35	1.01
0095	BioD	55.9	47.1	57.6	58.95	57.58	2.72	0.70
0096	S-8, JP-8; SASOL (1:2:1)	49.6	50.2	51.0	48.86	54.73	1.20	1.04
0097	ULSD + CI (min. treat rate)	48.7	48.9	54.0	51.62	46.94	1.00	0.45
0098	ULSD + CI (max. treat rate)	48.6	48.8	53.5	54.27	54.27	1.16	0.31
0099	JP-8	45.1	42.0	46.1	45.19	46.74	1.69	0.41
0100	S-8:JP-8 (1:1)	56.7	53.4	52.9	52.37	52.79	0.84	0.57
0101	JP-8:BioD (4:1)	42.4	40.1	47.6	49.86	51.41	0.59	0.38
0102	JP-8:SASOL (1:1)	58.9	59.1	63.8	62.21	61.96	1.78	0.19
0103	JP-8 + CI (min. treat rate)	44.5	41.3	51.7	53.64	54.29	0.69	0.91
0104	JP-8 + CI (max. treat rate)	44.5	41.1	53.8	56.57	56.31	1.11	0.14
0105	JP-8:BioD (4:1) + CI (min. treat rate)	42.4	40.0	53.8	54.10	54.35	1.00	0.36
0106	JP-8:BioD (4:1) + CI (max. treat rate)	42.2	39.8	54.8	56.73	56.95	1.41	0.27
0107	JP-8:SASOL:BioD (8:1:1)	45.7	43.8	49.8	52.05	52.24	0.84	0.07
0108	ULSD:BioD (4:1)	49.4	50.2	49.1	48.79	48.97	1.07	0.46
0109	S-8:JP-8:BioD (1:8:1)	45.5	43.0	49.2	48.53	51.42	0.95	0.63
0110	JP-8:SASOL:BioD (2:2:1)	58.8	59.4	60.6	63.72	63.50	1.19	0.24
0111	S-8:JP-8:BioD (2:2:1)	50.1	50.6	54.2	54.71	56.04	1.25	0.30
0112	S-8:JP-8:SASOL (1:1:2)	65.9	65.8	67.4	67.97	64.47	1.22	0.57
0113	S-8:JP-8:SASOL (2:1:1)	64.3	62.4	61.1	62.64	59.52	0.98	0.32

Table 11. API Specific Gravities and Distillation Data from D4052 and D86 used for Calculating Cetane Index in D4737 and D976

Sample Code CL08-	D4052		D86 – Distillation (°F)																
	API gravity	Specific Gravity	IBP	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	95%	FBP	Rec. (%)	Res. (%)	Loss (%)
0092	36.7	0.8413	359	392	408	423	436	459	481	500	52	540	563	595	621	645	97.7	1.4	0.9
0093	55.9	0.7549	305	325	331	338	346	362	379	396	414	433	454	482	502	529	98.3	0.5	1.2
0094	51.1	0.7749	341	388	405	418	428	453	480	509	540	571	605	645	672	687	97.4	1.5	1.1
0095	28.5	0.8845	149	625	630	628	631	631	633	634	636	638	642	649	631	645	65.5	2.3	2.2
0096	35.0	0.8498	366	401	422	438	453	482	507	533	558	582	605	628	641	650	67.8	1.0	1.2
0097	36.7	0.8415	358	396	413	427	437	461	481	501	520	539	563	593	619	644	68.4	1.2	0.4
0098	36.6	0.8416	357	390	409	424	436	459	480	499	519	539	562	592	619	645	97.8	1.0	1.2
0099	47.3	0.7916	290	314	317	324	328	340	352	367	383	404	428	457	477	499	98.3	1.0	0.7
0100	51.5	0.7732	294	319	323	330	334	349	363	380	398	419	443	472	492	518	98.1	1.1	0.8
0101	43.2	0.8102	269	313	319	327	334	349	366	388	416	459	550	632	641	659	98.5	0.8	0.7
0102	49.2	0.7833	300	330	3337	349	357	377	398	423	453	489	534	602	647	669	97.3	1.6	1.1
0103	47.2	0.7918	283	312	315	323	327	339	351	365	381	402	427	457	476	498	98.5	1.1	0.44
0104	47.2	0.7920	287	312	317	321	326	338	349	363	380	401	426	456	47	500	97.9	1.0	1.1
0105	43.2	0.8101	289	317	321	330	336	352	368	389	418	459	549	631	642	658	99.1	0.8	0.1
0106	43.1	0.8104	287	316	320	329	335	348	365	387	415	457	550	631	641	662	98.4	0.7	0.9
0107	45.6	0.7989	288	317	320	327	335	349	366	385	409	441	487	588	630	646	98.2	1.0	0.8
0108	35.0	0.8497	357	393	417	435	451	479	508	534	559	583	607	629	644	661	98.2	0.7	1.1
0109	46.0	0.7972	285	312	320	325	331	344	361	378	399	425	461	548	623	641	97.9	1.0	1.1
0110	44.7	0.8033	312	336	348	359	370	396	430	471	524	580	619	641	658	678	98.4	0.6	1.0
0111	46.4	0.7956	288	321	326	335	344	362	383	407	435	476	560	631	642	660	98.3	0.6	1.1
0112	51.3	0.7742	311	335	347	354	366	387	409	434	462	495	538	602	645	667	96.5	1.4	2.1
0113	52.5	0.7692	307	326	335	342	350	369	388	409	432	457	489	543	602	637	96.9	1.5	1.6

2.6 STATISTICAL ANALYSIS

The purpose of statistical analysis is to compare DCN values, from IQT experiments, obtained from two different sources namely SwRI and Wayne State University.

a. *Correlation*: The coefficient of correlation determines the degree of similarity between the mean DCN values of all the 22 samples obtained from SwRI and WSU. The coefficient of correlation was calculated to be 0.9529. This implies that the degree of similarity, of DCN results, between SwRI and WSU is 95.29%. Hence it can be inferred from the coefficient of correlation that the two sources yield statistically similar results.

b. *Statistical Analysis*: DCN results from SwRI had a total of 32 runs per fuel sample (Appendix 1), while WSU reported a total of 4 runs per fuel sample (Appendix 2). The mean and standard deviation values of DCN for each fuel sample at SwRI and WSU were reported in Table 10. *t*-test and *F*-test were used to check if the mean values and standard deviations reported in Table 10 are equal. The results obtained at 95% and 99% confidence intervals are reported in Table 12.

   The *t*-test results indicates that the IQT DCN population mean values between SwRI and WSU (Appendix 1 and 2, respectively) are similar for 50% of the fuel blends and the *F*-test results show that the population variance values are equal for 63% of the fuel blends. Even though the mean DCN values for SwRI and WSU, in Table 10, have a 95% correlation coefficient, the results from *t*-test and *F*-test indicates that the population mean and variances of SwRI and WSU do not have a high degree of similarity. A possible reason could be due difference in size of the sample set; four runs on WSU IQT as compared to thirty runs on SwRI IQT. A larger sample size from WSU might possibly lead yield a better degree of similarity between the population means and variances between SwRI and WSU IQT DCN data.

Table 12. Statistical Analysis of IQT Data

Sample Code CL08-	Fuel Sample	*F*-test (2 tailed)	Similarity in Variance (Equal/ Not equal)	*t*-test (2 tailed)	Degree of Similarity in mean DCN values	
					95% Confidence Interval	99% Confidence Interval
0092	EPA Certified ULSD	0.406	Equal	0.9587	NO	NO
0093	S-8	0.297	Equal	0.0000	YES	YES
0094	SASOL	0.016	Not equal	0.0000	YES	YES
0095	BioD	0.045	Not equal	0.0140	YES	NO
0096	S-8, JP-8; SASOL (1:2:1)	0.937	Equal	0.0000	YES	YES
0097	ULSD + CI (min. treat rate)	0.209	Equal	0.0000	YES	YES
0098	ULSD + CI (max. treat rate)	0.050	Equal	0.9378	NO	NO
0099	JP-8	0.412	Equal	0.0001	YES	YES
0100	S-8:JP-8 (1:1)	0.382	Equal	0.4152	NO	NO
0101	JP-8:BioD (4:1)	0.502	Equal	0.00000	YES	YES
0102	JP-8:SASOL (1:1)	0.004	Not equal	0.3373	NO	NO
0103	JP-8 + CI (min. treat rate)	0.364	Equal	0.0975	NO	NO
0104	JP-8 + CI (max. treat rate)	0.005	Not equal	0.1780	NO	NO
0105	JP-8:BioD (4:1) + CI (min. treat rate)	0.114	Equal	0.6554	NO	NO
0106	JP-8:BioD (4:1) + CI (max. treat rate)	0.019	Not equal	0.5726	NO	NO
0107	JP-8:SASOL:BioD (8:1:1)	0.001	Not equal	0.2675	NO	NO
0108	ULSD:BioD (4:1)	0.181	Equal	0.7967	NO	NO
0109	S-8:JP-8:BioD (1:8:1)	0.553	Equal	0.0000	YES	YES
0110	JP-8:SASOL:BioD (2:2:1)	0.024	Not equal	0.3842	NO	NO
0111	S-8:JP-8:BioD (2:2:1)	0.038	Not equal	0.0001	YES	YES
0112	S-8:JP-8:SASOL (1:1:2)	0.232	Equal	0.0000	YES	YES
0113	S-8:JP-8:SASOL (2:1:1)	0.091	Equal	0.0000	YES	YES

3.0 CONCLUSION

The addition of Nalco 5403 additive improved the lubricity of S-8 at 12 mg/L and 22.5 mg/L treat rates from BOCLE results. The addition of DCI-4A had a marked effect on improving the lubricity of S-8 at 9 mg/L treat rate. There was no improvement in lubricity as the treat rate was increased to 22.5 mg/L. BOCLE results show that Nalco 5403 and DCI-4A had negligible effect in improving the lubricity of Jet A. Since the lubricity values were within the repeatability limit of 0.08 mm, it can also be concluded that there is no trend as the concentration of the additives were increased. The dilution of the synthetic fuel (S-8), by 50%, with petroleum fuel (JP-8, Jet A), results in the improvement of lubricity of the synthetic fuel to the level of petroleum fuel as indicated in the BOCLE results.

For all the fuels and for both the additives, HFRR method is not capable of differentiating untreated and treated jet fuels, whether synthetic or petroleum, with the additions of military-approved additives from the QPL at the relatively low treat rates that are allowed for this additive in jet fuel used by the military. Nalco 5403 and DCI-4A did not have an effect in improving the lubricity of the synthetic fuel (S-8), petroleum fuel (Jet A) and 50/50 blend of S-8/JP-8, S-8/Jet A based on SLBOCLE repeatability value of 900 grams. DCI-4A had slightly improved the lubricity of S-8/Jet A blend at 22.5 mg/l treat rate compared to the neat blend. The addition of petroleum fuel, by 50%, to synthetic fuel improves the lubricity of synthetic fuel, per SLBOCLE results.

The cetane indices measured by D976 and D4737 did not account for the effect of cetane improvers in the fuel samples. This was verified by the addition of cetane improver (2-ethyl hexyl nitrate) at 0.135% and 0.270% of the weight of the sample. The results did not have any improvement in cetane indices for ULSD, S-8, SASOL, biodiesel and JP-8. However, the cetane improver additives did show an improvement in cetane ratings by D6890-7a and the IQT tests.
The Cetane Index equations were designed for regular petroleum diesel fuel and have been used for JP-8, since JP-8 can also be classified as a No. 1 petroleum diesel fuel. However, S-8 and SASOL are synthetic fuels and their distillation range is not as same as petroleum diesel fuels. This leads to inconsistent Cetane Index results of fuel blends with synthetic fuels, biodiesel and

ULSD. The cetane rating measured by D613-05 is based on testing conducted in a cetane engine and D6890-7A is based on Ignition Quality Tester (IQT) that correlates results back to the cetane engine to obtain Derived Cetane Number (DCN). The cetane ratings, unlike the cetane indices, are based on ignition delay in the engine and is irrespective of API specific gravity or distillation data of the fuel/fuel blend. Thus cetane ratings should be used to account for fuel blend combustion quality.

It can be concluded, in general, that blends with a higher ratio of a component with a high cetane rating will have an overall higher cetane rating. Blends with a higher ratio of a component with a low cetane rating will have an overall lower cetane rating. It can also be concluded that cetane ratings, for fuel blends containing synthetic fuels, biodiesel and ULSD, can be better predicted by Cetane Number (D613-05) and IQT DCN (D6890-7a) as opposed to Cetane Index equations by D4737 and D976. The data obtained from SwRI and WSU was determined to have a correlation of 95.29%. However, from *t*-test and *F*-test, statistics it can be concluded that the population means and variances do not have a high degree of similarity based on 95% and 99% confidence intervals.

APPENDIX – I

IQT™ Results - Run Details

Run ID: 914
Fuel ID: CL08-00092
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 2:00:19 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	4.608	43.47	309.7	175.0	557.8	146.7	49.7	35.2	587.1
2	4.659	43.05	309.7	175.0	558.0	148.7	49.6	35.3	588.7
3	4.608	43.48	309.7	175.0	557.8	150.4	49.7	35.3	587.6
4	4.695	42.75	309.7	175.0	557.1	152.0	49.6	35.3	587.2
5	4.656	43.08	309.7	175.0	557.5	153.3	49.7	35.4	587.9
6	4.701	42.71	309.7	175.0	557.6	154.5	49.9	35.4	587.8
7	4.612	43.44	309.7	175.0	558.1	155.6	49.9	35.7	588.7
8	4.483	44.58	309.6	175.0	557.7	156.5	50.1	35.6	587.2
9	4.531	44.14	309.7	175.0	557.4	157.0	50.1	35.9	587.8
10	4.681	42.87	309.7	175.0	557.4	157.6	50.2	36.0	587.9
11	4.532	44.14	309.8	175.0	557.2	158.1	50.4	36.2	587.1
12	4.688	42.81	309.8	175.0	557.6	158.8	50.4	36.4	588.3
13	4.597	43.57	309.8	175.0	557.1	159.4	50.6	36.4	586.9
14	4.603	43.51	309.8	175.0	556.8	159.9	50.7	36.5	587.2
15	4.624	43.34	309.8	175.0	556.9	160.2	50.7	36.8	587.3
16	4.739	42.40	309.8	175.0	557.1	159.7	50.9	36.9	586.9
17	4.538	44.08	309.8	175.0	557.6	157.1	50.9	37.0	587.8
18	4.442	44.95	309.8	175.0	557.5	155.9	51.2	37.0	586.5
19	4.586	43.66	309.8	175.0	557.5	154.7	51.2	37.1	588.0
20	4.704	42.68	309.9	175.0	557.3	153.0	51.1	37.1	587.4
21	4.466	44.73	309.8	175.0	556.6	151.8	51.1	37.1	587.5
22	4.576	43.75	309.8	175.1	557.3	150.4	51.2	37.2	588.0
23	4.457	44.81	309.8	175.1	557.1	149.3	51.1	37.1	587.2
24	4.578	43.73	309.8	175.0	557.5	148.3	51.1	37.0	588.3
25	4.661	43.03	309.8	175.0	557.5	147.3	51.0	37.0	587.8
26	4.659	43.05	309.8	175.1	557.6	147.4	51.0	36.9	588.3
27	4.578	43.73	309.8	175.1	557.8	146.5	51.0	36.8	588.6
28	4.643	43.19	309.7	175.1	557.5	146.2	50.8	36.8	587.3
29	4.701	42.70	309.8	175.1	558.0	145.8	50.8	36.6	589.0
30	4.723	42.53	309.8	175.0	558.1	145.5	50.8	36.5	588.1
31	4.506	44.36	309.7	175.0	557.8	145.2	50.7	36.5	587.6
32	4.790	42.00	309.7	175.1	557.8	144.7	50.7	36.4	588.3
Avg.:	4.613	43.43	309.8	175.0	557.5	152.4	50.6	36.4	587.7
Min:	4.442	42.00	309.6	175.0	556.6	144.7	49.6	35.2	586.5
Max:	4.790	44.95	309.9	175.1	558.1	160.2	51.2	37.2	589.0
Range:	0.348	2.95	0.3	0.1	1.5	15.6	1.6	2.0	2.5
Std. Dev.:	0.087	0.75	0.1	0.0	0.4	5.2	0.5	0.7	0.6

IQT™ Results - Run Details

Run ID: 915
Fuel ID: CL08-00093
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 2:22:02 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	3.351	59.80	309.8	175.0	555.9	150.2	50.9	36.8	586.5	
2	3.397	58.89	309.8	175.0	555.5	149.1	50.9	36.8	586.7	
3	3.362	59.57	309.8	175.0	555.8	147.5	50.8	36.8	586.8	
4	3.335	60.13	309.8	175.0	555.7	146.5	50.8	36.8	586.5	
5	3.256	61.79	309.7	175.0	555.6	146.2	50.8	36.8	587.4	
6	3.437	58.13	309.8	175.0	556.0	145.3	50.7	36.6	586.8	
7	3.404	58.77	309.7	175.0	556.5	144.8	50.8	36.7	588.3	
8	3.312	60.59	309.7	175.0	556.3	144.0	50.7	36.6	587.1	
9	3.329	60.24	309.7	175.0	556.4	143.8	50.7	36.6	587.3	
10	3.346	59.90	309.7	175.0	556.4	142.6	50.7	36.5	587.1	
11	3.348	59.86	309.8	175.0	556.5	142.2	50.6	36.4	587.6	
12	3.389	59.06	309.7	175.1	557.0	142.4	50.5	36.3	588.0	
13	3.317	60.49	309.7	175.0	556.4	142.6	50.4	36.2	586.7	
14	3.249	61.95	309.7	175.0	556.9	142.3	50.3	36.1	588.2	
15	3.334	60.13	309.7	175.0	556.9	142.6	50.4	35.9	587.2	
16	3.390	59.02	309.6	175.0	556.9	142.2	50.2	35.9	588.2	
17	3.313	60.58	309.7	175.0	557.2	142.3	50.2	35.8	588.2	
18	3.426	58.34	309.7	175.0	556.8	142.4	50.0	35.7	587.3	
19	3.306	60.72	309.6	175.0	557.4	142.4	49.9	35.6	588.8	
20	3.310	60.64	309.7	175.1	557.4	143.0	50.0	35.5	587.7	
21	3.360	59.62	309.7	175.1	557.2	143.4	49.9	35.4	587.6	
22	3.284	61.18	309.7	175.0	557.4	143.8	49.7	35.4	587.9	
23	3.263	61.65	309.7	175.0	557.0	143.6	49.7	35.2	587.9	
24	3.320	60.43	309.6	175.0	557.8	143.9	49.6	35.2	588.1	
25	3.312	60.59	309.8	175.0	557.2	144.5	49.6	35.0	586.9	
26	3.297	60.91	309.8	175.1	557.3	144.3	49.6	35.0	587.7	
27	3.311	60.62	309.8	175.0	557.1	144.3	49.4	34.9	587.3	
28	3.340	60.02	309.8	175.0	557.2	146.3	49.5	34.8	588.1	
29	3.328	60.27	309.8	175.0	557.3	148.1	49.4	34.9	587.2	
30	3.233	62.30	309.6	175.0	557.2	149.7	49.5	34.9	588.1	
31	3.300	60.85	309.7	175.0	557.1	151.1	49.4	34.9	588.0	
32	3.334	60.15	309.7	175.0	556.6	152.4	49.4	35.0	587.1	
Avg.:	3.331	60.20	309.7	175.0	556.7	145.0	50.2	35.8	587.5	
Min:	3.233	58.13	309.6	175.0	555.5	142.2	49.4	34.8	586.5	
Max:	3.437	62.30	309.8	175.1	557.8	152.4	50.9	36.8	588.8	
Range:	0.204	4.17	0.3	0.1	2.3	10.3	1.5	2.0	2.4	
Std. Dev.:	0.049	0.99	0.1	0.0	0.6	2.9	0.5	0.7	0.6	

IQT™ Results - Run Details

Run ID: 916
Fuel ID: CL08-00094
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 2:43:24 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	2.691	78.93	309.6	175.0	556.9	142.8	50.2	35.9	587.5
2	2.668	79.88	309.6	175.0	556.9	142.7	50.1	35.7	587.2
3	2.696	78.71	309.6	175.0	557.1	143.4	50.1	35.7	587.8
4	2.655	80.45	309.7	175.0	556.6	143.2	49.9	35.5	587.1
5	2.628	81.68	309.6	175.0	556.6	143.0	49.8	35.5	588.1
6	2.674	79.65	309.7	175.0	556.9	143.0	49.8	35.4	587.1
7	2.644	80.96	309.8	175.0	557.3	143.3	49.8	35.4	588.4
8	2.744	76.75	309.7	175.0	557.3	143.3	49.6	35.2	587.3
9	2.637	81.29	309.7	175.0	556.7	143.7	49.5	35.1	587.7
10	2.692	78.85	309.7	175.0	557.1	143.5	49.5	35.0	587.5
11	2.707	78.24	309.8	175.0	556.9	145.4	49.5	34.9	588.1
12	2.675	79.58	309.7	175.0	556.8	147.5	49.4	34.9	587.5
13	2.684	79.19	309.7	175.0	557.1	149.2	49.4	34.8	588.6
14	2.712	78.02	309.7	175.0	557.5	150.7	49.4	34.8	587.5
15	2.664	80.05	309.6	174.9	556.9	152.0	49.5	35.0	588.2
16	2.646	80.85	309.6	174.9	557.1	153.0	49.6	35.0	588.4
17	2.648	80.79	309.6	175.0	556.9	153.9	49.7	35.2	586.7
18	2.684	79.21	309.6	175.0	556.8	154.8	49.7	35.3	588.4
19	2.648	80.77	309.6	174.9	556.6	155.7	49.7	35.5	587.6
20	2.660	80.26	309.6	174.9	556.3	156.4	49.8	35.6	587.1
21	2.677	79.52	309.7	174.9	556.6	157.1	50.0	35.7	587.7
22	2.626	81.78	309.7	174.9	556.3	157.4	50.1	35.9	587.3
23	2.673	79.68	309.7	174.9	556.3	157.7	50.2	36.0	588.0
24	2.700	78.55	309.7	174.9	556.5	158.0	50.4	36.3	586.7
25	2.658	80.33	309.7	174.9	556.5	158.3	50.6	36.4	587.4
26	2.634	81.42	309.8	174.9	556.4	158.0	50.6	36.5	586.9
27	2.624	81.85	309.7	174.9	556.7	155.8	50.7	36.6	588.1
28	2.619	82.10	309.8	174.9	556.7	154.4	50.8	36.8	587.2
29	2.613	82.37	309.8	174.9	556.1	153.2	50.9	36.9	587.0
30	2.699	78.56	309.7	175.0	556.3	151.9	50.9	36.9	587.5
31	2.679	79.40	309.8	174.9	556.3	150.9	50.9	36.8	587.4
32	2.698	78.62	309.8	175.0	556.6	149.8	50.9	36.9	587.5
Avg.:	2.667	79.92	309.7	175.0	556.7	150.4	50.0	35.7	587.6
Min:	2.613	76.75	309.6	174.9	556.1	142.7	49.4	34.8	586.7
Max:	2.744	82.37	309.8	175.0	557.5	158.3	50.9	36.9	588.6
Range:	0.131	5.62	0.3	0.1	1.4	15.5	1.4	2.1	1.9
Std. Dev.:	0.031	1.35	0.1	0.0	0.3	5.8	0.5	0.7	0.5

IQT™ Results - Run Details

Run ID: 919
Fuel ID: CL08-00095
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 7:45:32 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.359	59.64	309.7	175.1	555.8	157.6	50.9	37.0	586.5
2	3.388	59.06	309.7	175.1	555.9	158.1	51.1	37.0	586.6
3	3.393	58.98	309.7	175.1	555.7	158.7	51.1	37.1	586.8
4	3.350	59.82	309.8	175.1	555.6	159.1	51.2	37.2	585.9
5	3.445	57.98	309.8	175.1	555.8	159.5	51.2	37.3	586.5
6	3.437	58.14	309.8	175.1	555.8	159.6	51.4	37.3	586.5
7	3.612	55.10	309.8	175.1	555.8	159.7	51.4	37.4	586.3
8	3.320	60.44	309.8	175.1	555.9	159.8	51.5	37.5	586.8
9	3.430	58.27	309.8	175.1	555.6	160.1	51.5	37.6	586.0
10	3.308	60.68	309.8	175.1	555.5	160.2	51.5	37.7	587.8
11	3.182	63.49	309.8	175.1	555.9	158.8	51.6	37.8	586.6
12	3.527	56.52	309.8	175.1	555.4	156.8	51.7	37.9	586.6
13	3.433	58.21	309.8	175.1	555.6	156.1	51.7	37.9	586.8
14	3.557	56.00	309.9	175.2	555.4	154.8	51.8	37.8	586.9
15	3.564	55.88	309.8	175.1	555.8	153.5	51.6	37.9	586.9
16	3.598	55.32	309.8	175.2	555.5	152.3	51.7	37.8	587.0
17	2.948	69.75	309.9	175.1	556.0	151.1	51.6	37.6	587.5
18	3.557	56.00	309.7	175.1	555.8	150.8	51.5	37.6	586.8
19	3.263	61.64	309.7	175.2	556.0	150.2	51.4	37.5	587.4
20	3.334	60.14	309.8	175.1	555.8	149.7	51.4	37.3	586.8
21	3.358	59.65	309.7	175.2	556.1	149.4	51.4	37.3	587.7
22	3.352	59.79	309.8	175.2	556.3	148.8	51.2	37.1	586.6
23	3.488	57.20	309.7	175.2	556.2	148.1	51.1	36.9	587.9
24	3.406	58.71	309.6	175.2	556.4	147.0	51.0	36.8	586.5
25	3.474	57.45	309.6	175.1	556.2	147.0	50.9	36.6	587.8
26	3.387	59.09	309.6	175.2	556.4	146.7	50.8	36.4	587.4
27	3.328	60.27	309.6	175.2	556.3	146.5	50.7	36.4	587.7
28	3.361	59.61	309.7	175.2	556.5	146.5	50.6	36.2	588.2
29	3.438	58.12	309.6	175.2	556.1	146.0	50.5	36.1	586.8
30	3.321	60.41	309.6	175.2	556.1	146.7	50.3	35.9	588.3
31	3.396	58.91	309.6	175.1	556.5	148.5	50.3	35.8	587.1
32	3.300	60.85	309.5	175.1	556.4	150.3	50.1	35.7	588.3
Avg.:	3.394	58.95	309.7	175.1	555.9	153.1	51.2	37.1	587.0
Min:	2.948	55.10	309.5	175.1	555.4	146.0	50.1	35.7	585.9
Max:	3.612	69.75	309.9	175.2	556.5	160.2	51.8	37.9	588.3
Range:	0.664	14.65	0.4	0.2	1.1	14.2	1.7	2.1	2.5
Std. Dev.:	0.129	2.72	0.1	0.0	0.3	5.2	0.5	0.6	0.7

IQT™ Results - Run Details

Run ID: 920
Fuel ID: CL08-00096
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 8:08:06 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	4.139	48.04	309.9	175.0	556.6	151.0	51.8	37.8	586.5
2	4.010	49.53	309.7	175.1	556.5	150.5	51.8	37.9	587.3
3	4.154	47.86	309.9	175.1	556.6	149.9	51.6	37.7	587.1
4	4.105	48.42	309.8	175.1	556.6	149.1	51.6	37.7	587.2
5	4.018	49.44	309.8	175.1	557.0	149.1	51.6	37.6	588.0
6	4.214	47.21	309.9	175.1	556.9	148.5	51.5	37.5	586.6
7	4.234	47.01	309.7	175.1	557.1	147.6	51.4	37.4	588.0
8	4.158	47.82	309.7	175.1	557.4	146.8	51.3	37.2	587.1
9	3.934	50.47	309.8	175.2	557.1	146.1	51.2	37.1	587.7
10	4.063	48.90	309.7	175.1	557.4	146.3	51.1	37.0	587.2
11	3.895	50.97	309.7	175.2	557.5	145.9	51.0	36.8	588.4
12	4.185	47.53	309.7	175.1	557.8	145.2	51.0	36.6	587.5
13	4.099	48.48	309.6	175.2	557.6	144.7	50.8	36.5	587.8
14	4.121	48.24	309.7	175.2	557.8	144.9	50.7	36.4	588.7
15	3.987	49.82	309.7	175.2	557.9	144.9	50.6	36.3	587.1
16	3.990	49.78	309.7	175.2	557.7	145.1	50.5	36.1	588.6
17	4.084	48.66	309.6	175.1	558.0	146.0	50.4	35.9	587.5
18	3.904	50.87	309.6	175.1	557.7	147.9	50.3	35.8	588.5
19	3.990	49.78	309.6	175.1	558.2	149.9	50.2	35.7	588.5
20	4.070	48.82	309.6	175.1	558.0	151.7	50.2	35.7	587.6
21	3.984	49.85	309.6	175.1	558.2	153.0	50.2	35.6	588.5
22	4.106	48.40	309.7	175.1	558.1	154.2	50.2	35.7	587.2
23	4.115	48.31	309.6	175.0	557.7	155.0	50.2	35.7	588.4
24	4.114	48.32	309.6	175.1	557.8	156.0	50.2	35.8	587.4
25	4.013	49.49	309.6	175.1	558.1	156.6	50.3	35.9	588.8
26	4.097	48.51	309.8	175.0	558.3	157.1	50.3	35.9	588.1
27	3.781	52.53	309.8	175.1	557.8	157.6	50.3	36.0	586.8
28	4.113	48.32	309.7	175.1	558.1	158.1	50.4	36.2	588.4
29	4.064	48.89	309.7	175.1	557.9	158.7	50.5	36.3	587.8
30	4.139	48.03	309.8	175.1	557.5	159.2	50.5	36.3	587.4
31	4.185	47.52	309.7	175.1	557.8	159.7	50.6	36.4	588.0
32	4.075	48.76	309.8	175.1	557.1	159.9	50.7	36.5	587.1
Avg.:	4.067	48.86	309.7	175.1	557.6	151.1	50.8	36.5	587.7
Min:	3.781	47.01	309.6	175.0	556.5	144.7	50.2	35.6	586.5
Max:	4.234	52.53	309.9	175.2	558.3	159.9	51.8	37.9	588.8
Range:	0.453	5.52	0.3	0.2	1.8	15.1	1.6	2.3	2.3
Std. Dev.:	0.100	1.20	0.1	0.0	0.5	5.2	0.5	0.7	0.6

IQT™ Results - Run Details

Run ID: 921
Fuel ID: CL08-00097
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 8:30:26 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.857	51.49	309.9	175.1	556.4	143.8	50.8	36.6	586.7
2	3.745	53.05	309.9	175.1	556.7	143.5	50.7	36.4	587.8
3	3.816	52.04	309.8	175.1	556.4	143.3	50.6	36.3	587.2
4	3.763	52.79	309.7	175.1	556.4	143.9	50.5	36.1	588.5
5	3.798	52.29	309.7	175.1	556.7	145.1	50.3	36.0	588.0
6	3.906	50.83	309.7	175.0	556.6	147.0	50.3	35.9	587.6
7	3.889	51.06	309.6	175.0	556.9	148.8	50.2	35.8	588.4
8	3.850	51.58	309.7	175.1	557.0	150.4	50.2	35.7	587.5
9	3.805	52.19	309.6	175.1	556.9	151.9	50.1	35.7	588.4
10	3.825	51.92	309.7	175.0	557.0	153.1	50.2	35.7	587.3
11	3.846	51.64	309.8	175.0	556.9	154.0	50.4	35.9	588.2
12	3.856	51.50	309.7	175.0	556.8	154.8	50.3	35.8	587.6
13	3.705	53.65	309.7	175.1	556.8	155.7	50.3	35.9	587.9
14	3.906	50.83	309.7	175.1	556.9	156.5	50.4	36.1	587.8
15	3.882	51.14	309.7	175.0	556.8	156.9	50.4	36.1	587.6
16	3.812	52.10	309.8	175.0	556.8	157.2	50.4	36.3	588.3
17	3.921	50.64	309.8	175.1	556.8	158.0	50.5	36.4	586.9
18	3.844	51.67	309.8	175.0	557.2	158.6	50.6	36.5	588.6
19	3.932	50.50	309.8	175.1	557.0	159.2	50.7	36.6	587.7
20	3.717	53.47	309.8	175.0	556.9	159.6	50.8	36.6	587.4
21	3.907	50.83	309.9	175.0	556.7	159.7	50.8	36.8	587.5
22	3.982	49.87	309.8	175.1	556.4	159.9	51.0	36.8	587.7
23	3.826	51.91	309.8	175.1	556.7	160.2	50.8	36.8	587.7
24	4.015	49.47	309.8	175.1	556.5	160.3	51.0	36.9	587.4
25	3.759	52.86	309.9	175.1	556.5	160.6	51.0	37.0	587.8
26	3.736	53.18	309.9	175.1	556.3	160.8	51.1	37.1	587.2
27	3.853	51.53	309.8	175.1	556.6	161.0	51.2	37.2	587.5
28	3.815	52.06	310.0	175.1	556.5	161.3	51.3	37.3	587.9
29	3.838	51.75	309.8	175.1	556.9	161.7	51.4	37.4	588.4
30	3.931	50.51	309.8	175.0	556.7	161.7	51.5	37.5	586.7
31	3.853	51.54	309.9	175.0	556.6	161.6	51.4	37.5	588.4
32	3.923	50.61	309.8	175.0	556.7	161.8	51.5	37.6	588.1
Avg.:	3.847	51.62	309.8	175.1	556.7	155.4	50.7	36.5	587.7
Min:	3.705	49.47	309.6	175.0	556.3	143.3	50.1	35.7	586.7
Max:	4.015	53.65	310.0	175.1	557.2	161.8	51.5	37.6	588.6
Range:	0.311	4.18	0.4	0.1	0.9	18.6	1.4	1.9	1.8
Std. Dev.:	0.074	1.00	0.1	0.0	0.2	6.3	0.4	0.6	0.5

IQT™ Results - Run Details

Run ID: 922
Fuel ID: CL08-00098
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 8:58:11 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.668	54.22	309.9	175.1	555.9	158.4	51.1	37.1	586.7
2	3.807	52.17	309.9	175.1	556.2	159.1	51.1	37.2	586.8
3	3.772	52.66	309.9	175.0	556.0	159.4	51.1	37.3	587.2
4	3.635	54.73	309.9	175.0	555.7	159.9	51.2	37.4	586.4
5	3.623	54.92	309.9	175.0	556.0	160.3	51.4	37.5	587.6
6	3.690	53.87	309.9	175.0	555.8	160.2	51.4	37.5	586.2
7	3.554	56.05	310.0	175.0	555.7	158.8	51.4	37.7	587.6
8	3.694	53.81	309.9	175.0	556.5	157.9	51.5	37.7	587.1
9	3.673	54.12	309.9	175.1	556.0	156.8	51.6	37.6	586.4
10	3.620	54.96	309.9	175.1	556.9	155.5	51.6	37.7	588.0
11	3.700	53.72	309.9	175.1	556.6	154.2	51.6	37.7	586.7
12	3.710	53.57	309.9	175.1	556.7	153.5	51.5	37.6	588.0
13	3.677	54.07	309.9	175.1	557.0	152.7	51.5	37.5	587.6
14	3.648	54.52	309.9	175.1	556.7	151.9	51.4	37.5	586.8
15	3.578	55.65	309.8	175.1	557.1	151.7	51.3	37.3	587.8
16	3.482	57.30	309.9	175.0	557.2	151.3	51.2	37.2	586.9
17	3.770	52.69	309.9	175.0	557.2	150.2	51.1	37.0	588.3
18	3.705	53.64	309.9	175.1	557.3	149.2	51.1	37.0	587.2
19	3.728	53.30	309.9	175.1	557.2	149.3	50.9	36.8	588.0
20	3.713	53.53	309.9	175.0	557.2	148.9	50.8	36.7	587.5
21	3.558	55.98	309.8	175.1	557.4	148.5	50.8	36.5	588.2
22	3.622	54.93	309.9	175.1	557.8	148.1	50.7	36.3	587.5
23	3.671	54.16	309.9	175.1	557.5	147.9	50.6	36.3	587.9
24	3.601	55.27	309.8	175.1	557.5	147.9	50.6	36.0	588.3
25	3.683	53.98	309.7	175.1	557.6	149.6	50.4	36.0	587.2
26	3.718	53.45	309.8	175.0	557.7	151.6	50.4	35.9	588.5
27	3.683	53.98	309.8	175.0	557.8	153.2	50.3	35.8	587.6
28	3.662	54.31	309.9	175.0	557.2	154.5	50.2	35.8	588.2
29	3.613	55.08	309.8	175.0	557.6	155.7	50.1	35.8	588.2
30	3.519	56.65	309.9	175.0	557.4	156.7	50.2	35.8	587.6
31	3.745	53.05	309.7	175.0	557.5	157.6	50.3	35.8	588.1
32	3.728	53.30	309.8	175.0	557.2	158.3	50.3	35.9	587.3
Avg.:	3.664	54.27	309.9	175.0	556.9	154.0	51.0	36.8	587.5
Min:	3.482	52.17	309.7	175.0	555.7	147.9	50.1	35.8	586.2
Max:	3.807	57.30	310.0	175.1	557.8	160.3	51.6	37.7	588.5
Range:	0.324	5.13	0.3	0.2	2.1	12.4	1.4	2.0	2.3
Std. Dev.:	0.074	1.16	0.1	0.0	0.7	4.2	0.5	0.7	0.6

IQT™ Results - Run Details

Run ID: 923
Fuel ID: CL08-00099
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 9:20:31 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	4.301	46.31	309.8	174.9	556.0	153.9	52.1	38.4	587.2
2	4.341	45.92	309.9	174.9	556.4	152.4	52.1	38.3	586.8
3	4.262	46.71	310.0	174.9	556.0	151.5	52.1	38.3	585.6
4	4.369	45.64	309.9	174.9	556.4	151.3	52.0	38.2	586.8
5	4.364	45.69	309.9	174.9	556.0	150.9	52.0	38.0	585.9
6	4.364	45.70	309.9	175.0	556.0	150.0	51.9	38.1	587.1
7	4.384	45.50	309.9	174.9	555.7	149.6	51.8	38.0	586.3
8	4.453	44.85	309.9	174.9	556.2	149.3	51.8	37.7	587.6
9	4.398	45.36	309.9	174.9	556.6	149.2	51.6	37.7	586.5
10	4.508	44.35	310.0	174.9	556.9	148.9	51.5	37.6	587.5
11	4.312	46.20	309.9	174.9	557.0	148.3	51.4	37.3	587.4
12	4.440	44.97	309.9	174.9	556.6	147.5	51.5	37.2	585.9
13	4.393	45.42	309.9	174.9	557.0	147.8	51.3	37.1	587.7
14	4.457	44.81	309.9	174.9	556.9	147.8	51.1	36.9	587.2
15	4.447	44.90	309.9	174.9	556.8	147.3	51.1	36.8	586.9
16	4.382	45.52	309.9	174.9	557.1	147.6	51.0	36.7	587.3
17	4.443	44.94	309.9	174.9	557.1	149.4	50.9	36.5	587.1
18	4.404	45.31	309.8	174.8	557.3	151.2	50.8	36.4	587.5
19	4.558	43.91	309.8	174.8	557.4	152.9	50.7	36.4	586.9
20	4.460	44.78	309.8	174.8	557.4	154.2	50.6	36.4	587.5
21	4.441	44.96	309.8	174.8	557.1	155.3	50.7	36.4	586.5
22	4.544	44.03	309.8	174.8	557.5	156.5	50.7	36.4	588.5
23	4.556	43.92	309.9	174.8	557.7	157.0	50.7	36.5	587.8
24	4.379	45.55	309.9	174.8	557.5	157.7	50.8	36.6	586.0
25	4.520	44.24	309.8	174.8	557.3	158.2	50.7	36.6	587.3
26	4.422	45.13	309.9	174.8	556.9	158.8	50.8	36.7	586.7
27	4.395	45.39	309.8	174.8	557.2	159.3	50.8	36.9	587.6
28	4.333	46.00	309.8	174.8	557.3	159.7	51.0	36.9	587.4
29	4.478	44.62	309.9	174.7	557.0	160.3	51.1	36.9	586.5
30	4.360	45.73	309.8	174.7	557.1	160.7	51.2	37.0	586.9
31	4.472	44.67	309.9	174.7	557.1	161.2	51.2	37.2	587.1
32	4.370	45.63	309.9	174.8	557.2	161.5	51.3	37.2	587.5
Avg.:	4.416	45.19	309.9	174.9	556.9	153.3	51.3	37.2	587.0
Min:	4.262	43.91	309.8	174.7	555.7	147.3	50.6	36.4	585.6
Max:	4.558	46.71	310.0	175.0	557.7	161.5	52.1	38.4	588.5
Range:	0.296	2.81	0.2	0.2	2.0	14.2	1.5	2.0	2.9
Std. Dev.:	0.074	0.69	0.1	0.1	0.5	4.8	0.5	0.7	0.6

IQT™ Results - Run Details

Run ID: 924
Fuel ID: CL08-00100
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 9:43:27 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	3.699	53.74	309.8	174.8	556.7	154.5	50.8	36.4	587.4	
2	3.843	51.67	309.9	174.7	556.4	155.4	50.7	36.6	586.2	
3	3.711	53.55	309.9	174.7	556.5	156.3	50.8	36.6	587.1	
4	3.812	52.10	309.9	174.7	556.3	157.2	50.8	36.7	586.7	
5	3.901	50.91	309.9	174.7	556.3	157.9	50.8	36.7	586.8	
6	3.842	51.69	309.9	174.7	556.7	158.6	51.0	36.8	587.2	
7	3.805	52.20	309.9	174.7	556.3	159.0	51.0	36.9	586.0	
8	3.811	52.11	309.9	174.7	556.6	159.3	51.1	37.0	587.2	
9	3.844	51.67	309.9	174.7	556.6	159.7	51.1	37.0	585.9	
10	3.886	51.10	309.8	174.7	556.4	160.3	51.2	37.2	587.1	
11	3.828	51.88	309.9	174.7	556.3	160.6	51.3	37.2	586.3	
12	3.814	52.08	309.9	174.7	556.4	161.0	51.3	37.2	587.2	
13	3.825	51.92	309.9	174.7	556.6	161.1	51.4	37.3	586.6	
14	3.803	52.23	309.9	174.7	556.4	161.4	51.4	37.4	586.2	
15	3.730	53.27	310.0	174.7	556.4	161.6	51.4	37.6	587.1	
16	3.796	52.33	309.8	174.7	556.5	161.7	51.5	37.5	585.9	
17	3.700	53.72	309.9	174.7	556.3	161.9	51.7	37.7	587.2	
18	3.758	52.86	309.9	174.7	556.3	162.0	51.6	37.8	586.3	
19	3.814	52.07	309.8	174.7	556.2	162.2	51.8	37.8	586.9	
20	3.816	52.04	309.8	174.7	556.5	162.5	51.7	37.9	586.8	
21	3.828	51.88	309.8	174.7	556.1	162.6	51.8	37.9	586.4	
22	3.788	52.43	309.9	174.6	556.2	162.3	51.8	38.0	586.8	
23	3.846	51.63	309.9	174.7	555.9	161.1	51.9	38.1	586.0	
24	3.828	51.88	309.8	174.7	555.8	158.6	51.9	38.1	586.7	
25	3.774	52.64	309.9	174.7	555.6	157.6	51.9	38.1	586.3	
26	3.729	53.29	309.9	174.8	556.1	157.1	52.0	38.1	587.1	
27	3.828	51.87	309.9	174.8	556.0	155.3	52.0	38.1	586.1	
28	3.620	54.96	310.0	174.8	555.8	153.7	51.9	38.0	587.3	
29	3.750	52.98	310.0	174.7	556.2	153.0	51.9	37.9	586.6	
30	3.795	52.34	310.0	174.8	556.3	151.8	51.7	37.8	588.3	
31	3.805	52.19	310.0	174.7	556.5	150.9	51.8	37.7	587.0	
32	3.743	53.08	309.8	174.7	556.1	150.8	51.6	37.6	587.2	
Avg.:	3.793	52.37	309.9	174.7	556.3	158.4	51.5	37.5	586.7	
Min:	3.620	50.91	309.8	174.6	555.6	150.8	50.7	36.4	585.9	
Max:	3.901	54.96	310.0	174.8	556.7	162.6	52.0	38.1	588.3	
Range:	0.281	4.06	0.2	0.2	1.1	11.8	1.3	1.7	2.4	
Std. Dev.:	0.059	0.84	0.1	0.0	0.3	3.6	0.4	0.5	0.5	

IQT™ Results - Run Details

Run ID: 925
Fuel ID: CL08-00101
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 10:06:58 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	4.000	49.65	309.9	174.7	555.6	153.2	51.7	37.9	585.9	
2	4.100	48.47	310.0	174.7	555.7	151.8	51.7	37.9	587.0	
3	3.927	50.56	309.8	174.7	555.8	150.7	51.7	37.8	586.9	
4	3.959	50.17	309.9	174.7	555.7	149.8	51.6	37.7	586.3	
5	3.910	50.79	310.1	174.7	556.3	149.9	51.6	37.6	587.4	
6	4.072	48.79	309.9	174.8	556.3	149.7	51.5	37.4	586.2	
7	3.961	50.14	309.9	174.7	556.6	148.9	51.4	37.3	587.6	
8	3.856	51.50	310.0	174.8	556.4	148.2	51.3	37.2	587.1	
9	4.024	49.36	309.9	174.7	556.5	148.1	51.2	37.0	586.9	
10	3.964	50.10	309.9	174.7	556.8	148.0	51.1	37.0	587.5	
11	4.026	49.34	309.9	174.7	556.7	148.1	51.1	36.8	586.7	
12	4.013	49.49	310.0	174.7	557.1	148.5	50.9	36.6	587.8	
13	3.957	50.19	309.9	174.7	557.1	149.0	50.8	36.5	586.8	
14	3.991	49.76	309.8	174.7	557.3	150.9	50.7	36.4	588.0	
15	4.024	49.36	309.9	174.7	556.9	152.3	50.7	36.3	586.7	
16	3.997	49.68	309.8	174.6	556.6	153.8	50.6	36.3	587.7	
17	3.979	49.92	309.9	174.6	556.6	155.0	50.6	36.2	587.0	
18	3.948	50.30	309.9	174.6	556.6	156.0	50.5	36.3	588.1	
19	3.998	49.67	309.8	174.6	556.6	156.9	50.5	36.3	587.1	
20	3.952	50.25	309.8	174.6	556.5	157.7	50.5	36.3	587.5	
21	3.971	50.01	309.9	174.6	557.0	158.5	50.7	36.3	587.4	
22	4.034	49.24	309.9	174.6	556.7	159.1	50.7	36.5	586.9	
23	3.973	49.98	309.8	174.6	556.5	159.8	50.6	36.6	588.0	
24	3.932	50.50	309.9	174.6	556.5	160.3	50.7	36.5	586.5	
25	4.038	49.20	309.8	174.6	556.8	160.7	50.8	36.7	587.5	
26	3.998	49.68	309.9	174.6	556.9	161.1	50.9	36.7	587.0	
27	3.962	50.12	309.9	174.5	556.5	161.3	50.9	36.9	586.6	
28	3.921	50.64	309.9	174.5	556.7	161.6	50.9	36.9	587.3	
29	3.988	49.80	309.8	174.5	556.5	161.8	51.0	37.0	586.4	
30	4.001	49.64	309.9	174.6	556.7	161.9	51.1	37.2	588.2	
31	3.988	49.80	309.9	174.5	557.0	162.3	51.2	37.2	587.4	
32	3.990	49.77	309.9	174.5	556.2	162.5	51.2	37.3	586.2	
Avg.:	3.983	49.86	309.9	174.6	556.5	154.9	51.0	36.9	587.1	
Min:	3.856	48.47	309.8	174.5	555.6	148.0	50.5	36.2	585.9	
Max:	4.100	51.50	310.1	174.8	557.3	162.5	51.7	37.9	588.2	
Range:	0.244	3.03	0.3	0.3	1.7	14.5	1.2	1.8	2.2	
Std. Dev.:	0.048	0.59	0.1	0.1	0.4	5.4	0.4	0.5	0.6	

IQT™ Results - Run Details

Run ID: 912
Fuel ID: CL08-00102
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 1:16:59 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.106	65.34	309.8	175.1	557.5	146.3	49.4	35.0	587.4
2	3.060	66.55	309.9	175.1	557.1	147.9	49.4	35.0	587.4
3	3.066	66.38	309.9	175.1	557.6	149.6	49.5	35.0	587.9
4	3.306	60.72	309.9	175.1	557.4	151.0	49.5	35.2	586.9
5	3.209	62.86	309.7	175.1	557.6	152.3	49.6	35.3	588.8
6	3.142	64.45	309.8	175.1	557.2	153.4	49.7	35.3	587.7
7	3.174	63.66	309.8	175.1	557.0	154.5	49.6	35.6	587.0
8	3.245	62.04	309.7	175.1	557.4	155.3	50.0	35.7	588.1
9	3.240	62.16	309.7	175.1	556.9	156.3	50.1	35.8	586.8
10	3.203	62.98	309.7	175.0	557.1	157.0	50.1	36.0	587.7
11	3.193	63.23	309.6	175.1	557.1	157.8	50.3	36.1	587.2
12	3.156	64.11	309.7	175.1	556.8	158.3	50.3	36.2	587.1
13	3.221	62.58	309.8	175.1	556.8	158.9	50.5	36.4	587.9
14	3.300	60.84	309.7	175.1	556.5	157.0	50.6	36.5	586.5
15	3.272	61.44	309.7	175.1	556.5	154.7	50.7	36.7	587.4
16	3.316	60.52	309.7	175.1	556.7	153.2	50.7	36.7	586.6
17	3.255	61.81	309.7	175.1	556.7	151.9	50.8	36.8	588.3
18	3.307	60.71	309.7	175.1	557.1	151.1	50.7	36.8	587.9
19	3.168	63.82	309.7	175.1	556.7	150.4	50.9	36.9	586.6
20	3.182	63.47	309.7	175.1	556.9	149.3	50.9	36.8	588.2
21	3.290	61.06	309.7	175.1	556.7	148.5	50.8	36.8	587.7
22	3.271	61.48	309.7	175.1	556.5	147.8	50.8	36.6	587.6
23	3.225	62.48	309.6	175.1	557.0	147.2	50.8	36.7	587.8
24	3.220	62.60	309.7	175.1	557.0	146.9	50.7	36.5	588.2
25	3.251	61.91	309.6	175.2	556.9	146.2	50.6	36.4	587.9
26	3.328	60.27	309.7	175.1	556.7	145.9	50.7	36.4	587.6
27	3.328	60.26	309.7	175.2	556.8	145.1	50.5	36.4	588.1
28	3.292	61.02	309.7	175.2	556.7	145.3	50.5	36.2	588.0
29	3.337	60.08	309.7	175.1	556.8	145.4	50.5	36.1	588.3
30	3.328	60.26	309.7	175.1	557.1	145.2	50.4	36.0	587.5
31	3.259	61.73	309.7	175.1	557.2	144.9	50.3	36.0	588.8
32	3.343	59.97	309.8	175.2	557.2	144.8	50.3	35.8	587.7
Avg.:	3.237	62.21	309.7	175.1	557.0	150.6	50.3	36.1	587.6
Min:	3.060	59.97	309.6	175.0	556.5	144.8	49.4	35.0	586.5
Max:	3.343	66.55	309.9	175.2	557.6	158.9	50.9	36.9	588.8
Range:	0.283	6.58	0.3	0.1	1.1	14.1	1.5	1.9	2.3
Std. Dev.:	0.077	1.78	0.1	0.0	0.3	4.6	0.5	0.6	0.6

IQT™ Results - Run Details

Run ID: 926
Fuel ID: CL08-00103
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 10:34:14 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.733	53.22	309.8	174.3	555.6	159.1	51.2	37.3	586.3
2	3.752	52.95	309.9	174.3	555.4	159.6	51.3	37.4	586.0
3	3.727	53.31	309.8	174.3	555.5	159.7	51.5	37.4	586.5
4	3.680	54.03	309.8	174.2	555.4	160.1	51.3	37.6	585.5
5	3.801	52.25	309.8	174.2	555.3	160.3	51.5	37.7	586.5
6	3.700	53.73	309.8	174.2	555.6	160.6	51.6	37.8	585.9
7	3.756	52.89	309.8	174.2	556.2	160.9	51.7	37.8	586.7
8	3.636	54.71	309.9	174.2	555.8	160.9	51.7	38.0	585.9
9	3.679	54.04	309.9	174.2	555.9	159.5	51.7	38.0	586.3
10	3.717	53.46	309.8	174.2	556.1	157.7	51.8	38.1	585.9
11	3.742	53.09	309.9	174.1	556.3	156.6	51.9	38.1	587.0
12	3.745	53.06	309.8	174.2	556.1	155.7	51.8	38.1	585.8
13	3.614	55.06	309.8	174.2	555.8	154.4	51.9	38.1	587.1
14	3.677	54.07	309.9	174.2	556.5	153.3	51.9	38.0	586.5
15	3.721	53.40	309.9	174.2	556.3	152.4	51.8	37.9	586.9
16	3.737	53.17	309.8	174.2	556.6	151.2	51.8	37.9	587.4
17	3.749	53.00	309.9	174.2	556.4	150.5	51.6	37.7	586.5
18	3.705	53.64	309.9	174.2	556.7	150.0	51.6	37.6	587.3
19	3.661	54.32	309.9	174.2	556.5	148.8	51.5	37.4	587.0
20	3.768	52.72	310.0	174.1	556.9	148.3	51.5	37.4	588.2
21	3.681	54.02	310.0	174.1	557.1	147.7	51.3	37.2	586.7
22	3.683	53.99	310.0	174.2	556.7	147.3	51.3	37.0	587.6
23	3.693	53.82	310.0	174.1	557.1	147.8	51.2	36.9	587.2
24	3.639	54.66	310.0	174.1	557.0	147.5	51.0	36.8	587.3
25	3.763	52.79	310.0	174.1	557.3	146.8	50.9	36.6	588.1
26	3.731	53.26	309.9	174.1	556.8	146.6	50.7	36.5	587.1
27	3.649	54.51	309.9	174.0	557.2	147.6	50.7	36.4	588.3
28	3.712	53.54	309.9	174.0	557.2	149.6	50.7	36.3	587.2
29	3.613	55.09	309.8	174.0	557.3	151.2	50.5	36.2	588.0
30	3.689	53.88	309.8	173.9	557.6	152.8	50.5	36.2	587.7
31	3.725	53.35	309.7	174.0	556.9	154.2	50.6	36.2	586.9
32	3.701	53.71	309.9	173.9	556.9	155.4	50.5	36.2	588.0
Avg.:	3.706	53.64	309.9	174.1	556.4	153.6	51.3	37.3	586.9
Min:	3.613	52.25	309.7	173.9	555.3	146.6	50.5	36.2	585.5
Max:	3.801	55.09	310.0	174.3	557.6	160.9	51.9	38.1	588.3
Range:	0.189	2.84	0.3	0.4	2.2	14.4	1.4	2.0	2.8
Std. Dev.:	0.046	0.69	0.1	0.1	0.7	5.1	0.5	0.7	0.8

IQT™ Results - Run Details

Run ID: 932
Fuel ID: CL08-00104
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 1:02:33 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	3.532	56.43	309.8	174.9	555.7	148.9	50.1	35.6	586.9	
2	3.455	57.79	309.8	174.9	555.9	150.6	50.0	35.6	587.0	
3	3.473	57.46	309.8	174.9	556.0	152.1	50.0	35.8	586.1	
4	3.512	56.78	309.8	174.9	556.3	153.4	50.0	35.9	587.3	
5	3.438	58.11	309.8	174.9	556.0	154.5	50.2	35.9	586.2	
6	3.587	55.50	309.8	174.9	556.2	155.2	50.2	35.9	587.3	
7	3.479	57.36	309.9	174.9	556.0	156.2	50.2	36.1	586.8	
8	3.615	55.04	309.9	175.0	555.9	157.1	50.4	36.3	586.8	
9	3.500	56.98	309.9	175.0	556.4	157.6	50.4	36.4	587.3	
10	3.617	55.01	309.9	175.0	555.8	158.1	50.5	36.5	586.2	
11	3.489	57.19	309.9	174.9	555.8	158.8	50.6	36.6	587.3	
12	3.615	55.04	309.9	175.0	555.7	159.6	50.7	36.7	586.3	
13	3.528	56.50	309.9	174.9	555.8	159.9	50.7	36.9	587.4	
14	3.580	55.61	309.9	175.0	555.6	160.3	50.9	36.9	586.4	
15	3.481	57.33	309.9	175.0	555.7	160.5	50.9	37.1	587.4	
16	3.572	55.76	309.9	175.0	556.0	160.7	51.0	37.1	586.9	
17	3.550	56.12	309.9	175.0	555.4	161.1	51.1	37.2	586.6	
18	3.486	57.23	309.9	175.0	555.7	161.2	51.1	37.2	587.4	
19	3.631	54.79	309.9	175.0	555.7	161.2	51.3	37.4	586.1	
20	3.661	54.31	309.9	175.1	555.6	160.9	51.4	37.4	586.7	
21	3.558	55.98	309.9	175.1	555.7	158.9	51.4	37.6	586.1	
22	3.497	57.04	310.0	175.1	555.6	157.6	51.5	37.6	586.9	
23	3.525	56.55	309.9	175.1	555.8	156.5	51.5	37.7	586.1	
24	3.483	57.30	309.9	175.1	555.8	155.5	51.5	37.8	587.2	
25	3.567	55.84	310.0	175.2	555.7	153.9	51.5	37.8	586.6	
26	3.531	56.45	310.0	175.2	555.9	152.6	51.5	37.8	587.6	
27	3.454	57.82	310.0	175.2	555.8	151.6	51.5	37.7	586.7	
28	3.434	58.19	309.9	175.2	555.9	150.1	51.4	37.6	587.6	
29	3.381	59.20	309.9	175.2	555.9	149.9	51.5	37.5	587.3	
30	3.516	56.71	309.9	175.2	556.2	149.4	51.2	37.3	588.1	
31	3.527	56.52	309.8	175.2	556.3	149.7	51.3	37.4	587.5	
32	3.490	57.16	309.9	175.2	556.6	149.7	51.1	37.1	587.9	
Avg.:	3.524	56.57	309.9	175.0	555.9	155.7	50.9	36.9	586.9	
Min:	3.381	54.31	309.8	174.9	555.4	148.9	50.0	35.6	586.1	
Max:	3.661	59.20	310.0	175.2	556.6	161.2	51.5	37.8	588.1	
Range:	0.280	4.88	0.2	0.4	1.2	12.3	1.5	2.2	2.1	
Std. Dev.:	0.064	1.11	0.0	0.1	0.3	4.2	0.5	0.7	0.6	

IQT™ Results - Run Details

Run ID: 933
Fuel ID: CL08-00105
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 1:31:19 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	3.635	54.72	309.7	175.4	556.3	144.5	50.6	36.6	588.0	
2	3.595	55.37	309.9	175.4	556.6	144.4	50.6	36.5	586.7	
3	3.679	54.05	309.8	175.4	556.7	144.7	50.6	36.4	587.1	
4	3.799	52.28	309.7	175.4	556.8	144.9	50.4	36.2	586.8	
5	3.540	56.30	309.7	175.4	556.9	144.5	50.5	36.1	587.7	
6	3.756	52.90	309.8	175.5	556.8	144.7	50.4	36.0	587.3	
7	3.723	53.38	309.7	175.5	556.6	144.7	50.4	35.9	587.0	
8	3.750	52.98	309.8	175.4	557.2	145.5	50.2	35.8	587.5	
9	3.718	53.45	309.6	175.4	557.1	147.6	50.2	35.8	587.6	
10	3.673	54.13	309.6	175.4	557.2	149.7	50.0	35.7	588.5	
11	3.610	55.13	309.6	175.4	556.8	151.3	50.0	35.6	587.1	
12	3.639	54.66	309.7	175.4	557.1	153.0	50.1	35.7	587.9	
13	3.707	53.62	309.7	175.4	556.9	154.5	50.0	35.7	587.2	
14	3.633	54.76	309.8	175.4	556.5	155.6	50.1	35.8	588.1	
15	3.551	56.11	309.8	175.4	556.6	156.8	50.1	35.8	587.1	
16	3.701	53.71	309.9	175.4	556.7	157.7	50.2	36.0	587.6	
17	3.728	53.31	309.8	175.4	556.8	158.4	50.2	36.0	587.4	
18	3.668	54.21	309.9	175.4	556.4	159.0	50.3	36.1	586.9	
19	3.650	54.49	309.8	175.4	556.8	159.6	50.4	36.3	587.9	
20	3.697	53.76	309.9	175.4	556.3	160.1	50.5	36.4	586.4	
21	3.645	54.56	309.9	175.4	556.1	160.7	50.6	36.5	587.6	
22	3.706	53.62	309.9	175.4	556.3	161.1	50.7	36.7	586.5	
23	3.633	54.75	309.9	175.4	556.5	161.2	50.7	36.7	588.0	
24	3.744	53.07	310.0	175.4	556.8	161.5	50.9	36.9	587.3	
25	3.741	53.11	310.0	175.4	556.2	161.7	51.0	37.0	586.5	
26	3.624	54.91	310.0	175.5	555.9	161.9	51.1	37.0	587.8	
27	3.558	55.98	310.0	175.4	555.7	162.2	51.2	37.3	586.7	
28	3.741	53.11	310.0	175.5	556.2	162.5	51.3	37.2	587.8	
29	3.667	54.22	310.0	175.5	556.2	160.9	51.2	37.4	586.6	
30	3.717	53.46	309.9	175.5	555.9	158.7	51.4	37.5	587.1	
31	3.744	53.07	310.0	175.5	556.0	157.4	51.4	37.7	586.6	
32	3.637	54.70	310.0	175.5	555.7	155.9	51.5	37.7	588.0	
Avg.:	3.675	54.10	309.8	175.4	556.5	154.6	50.6	36.4	587.3	
Min:	3.540	52.28	309.6	175.4	555.7	144.4	50.0	35.6	586.4	
Max:	3.799	56.30	310.0	175.5	557.2	162.5	51.5	37.7	588.5	
Range:	0.259	4.02	0.5	0.1	1.4	18.1	1.6	2.1	2.1	
Std. Dev.:	0.064	1.00	0.1	0.0	0.4	6.8	0.5	0.6	0.6	

IQT™ Results - Run Details

Run ID: 911
Fuel ID: CL08-00106
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 12:54:46 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.542	56.25	309.7	175.0	555.7	144.1	50.4	36.3	586.2
2	3.644	54.58	309.7	175.1	556.2	143.7	50.4	36.1	587.8
3	3.559	55.97	309.8	175.1	556.7	143.7	50.3	36.1	586.7
4	3.582	55.59	309.8	175.1	556.2	143.4	50.3	36.0	586.9
5	3.620	54.96	309.8	175.2	556.4	143.6	50.2	35.9	587.6
6	3.342	59.98	309.8	175.1	556.3	143.7	50.2	35.7	586.3
7	3.481	57.33	309.7	175.2	556.4	143.8	50.1	35.7	588.0
8	3.393	58.97	309.8	175.1	556.3	144.0	50.1	35.6	586.9
9	3.538	56.33	309.7	175.1	556.1	143.7	49.9	35.6	587.5
10	3.586	55.52	309.8	175.1	556.3	143.4	50.0	35.5	587.2
11	3.560	55.95	309.9	175.1	556.6	143.6	49.7	35.4	588.0
12	3.465	57.62	309.8	175.2	556.7	143.6	49.7	35.4	587.3
13	3.500	56.99	309.8	175.2	556.6	144.0	49.7	35.2	588.2
14	3.531	56.44	309.9	175.2	556.6	144.4	49.6	35.1	587.6
15	3.472	57.48	309.9	175.2	556.2	144.6	49.6	35.1	588.0
16	3.606	55.18	309.9	175.2	556.6	143.9	49.4	35.0	587.9
17	3.481	57.32	309.9	175.1	556.6	144.0	49.4	35.0	587.1
18	3.589	55.48	309.9	175.2	556.9	143.8	49.4	34.8	588.2
19	3.491	57.15	309.8	175.2	556.8	144.7	49.3	34.8	587.0
20	3.602	55.25	309.9	175.2	557.0	146.8	49.3	34.7	587.9
21	3.650	54.50	309.9	175.1	556.8	148.9	49.3	34.6	587.5
22	3.459	57.73	309.8	175.1	557.3	150.6	49.3	34.6	588.5
23	3.541	56.27	309.7	175.1	557.0	151.8	49.3	34.7	587.2
24	3.489	57.17	309.7	175.1	556.8	153.2	49.3	34.8	588.3
25	3.482	57.31	309.7	175.1	557.3	154.3	49.6	35.0	588.2
26	3.355	59.71	309.6	175.1	556.8	155.1	49.5	35.1	586.6
27	3.464	57.63	309.7	175.1	557.1	156.1	49.6	35.2	588.1
28	3.514	56.74	309.7	175.1	557.0	156.8	49.7	35.4	586.9
29	3.562	55.92	309.6	175.1	557.0	157.4	49.7	35.4	587.9
30	3.363	59.56	309.7	175.1	556.9	157.8	49.8	35.6	587.4
31	3.516	56.70	309.8	175.1	556.6	158.4	50.1	35.7	587.1
32	3.481	57.33	309.8	175.1	556.7	158.8	50.2	36.0	588.2
Avg.:	3.514	56.73	309.8	175.1	556.6	148.1	49.8	35.4	587.5
Min:	3.342	54.50	309.6	175.0	555.7	143.4	49.3	34.6	586.2
Max:	3.650	59.98	309.9	175.2	557.3	158.8	50.4	36.3	588.5
Range:	0.308	5.48	0.3	0.2	1.6	15.3	1.1	1.6	2.3
Std. Dev.:	0.079	1.41	0.1	0.0	0.4	5.7	0.4	0.5	0.6

IQT™ Results - Run Details

Run ID: 927
Fuel ID: CL08-00107
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 10:58:26 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.773	52.64	309.9	173.9	557.4	144.5	51.0	36.8	587.3
2	3.840	51.71	310.0	173.9	557.1	144.1	50.9	36.7	586.1
3	3.825	51.92	309.9	173.9	557.1	144.4	50.8	36.5	587.6
4	3.837	51.76	310.0	173.9	557.4	144.0	50.7	36.4	586.6
5	3.808	52.15	309.9	174.0	557.1	143.5	50.6	36.2	587.5
6	3.801	52.26	309.8	173.9	557.5	144.8	50.4	36.1	587.7
7	3.770	52.69	309.7	173.9	557.4	147.0	50.5	36.0	586.5
8	3.830	51.86	309.7	173.9	557.5	148.8	50.4	36.0	587.7
9	3.810	52.12	309.8	173.8	557.5	150.5	50.3	35.9	586.6
10	3.712	53.54	309.8	173.9	557.5	152.1	50.2	35.9	587.5
11	3.903	50.87	309.8	173.9	557.8	153.2	50.4	36.0	586.9
12	3.771	52.68	309.8	173.9	557.4	154.3	50.4	36.1	587.9
13	3.808	52.15	309.8	173.8	557.6	155.1	50.4	36.2	587.2
14	3.754	52.93	309.8	173.9	557.3	156.2	50.4	36.2	586.7
15	3.746	53.04	309.9	173.9	557.3	157.1	50.5	36.4	587.7
16	3.852	51.56	309.8	173.9	556.9	157.7	50.6	36.5	586.3
17	3.849	51.59	309.8	173.9	557.3	158.3	50.7	36.4	587.8
18	3.818	52.02	309.9	173.9	557.2	158.8	50.7	36.7	586.5
19	3.798	52.29	309.9	173.8	556.7	159.2	50.7	36.7	587.2
20	3.755	52.91	309.9	173.9	556.8	159.7	50.8	36.8	586.8
21	3.814	52.07	309.8	173.9	556.6	159.8	50.9	36.8	587.1
22	3.733	53.23	309.9	173.9	556.7	160.3	51.0	37.0	587.0
23	3.977	49.94	309.9	173.9	556.4	160.7	51.0	37.1	586.7
24	3.915	50.72	309.9	173.9	556.8	161.2	51.2	37.2	587.1
25	3.753	52.93	309.9	173.9	556.8	161.5	51.3	37.4	586.2
26	3.849	51.59	310.0	173.9	556.7	161.6	51.4	37.4	587.1
27	3.880	51.18	309.9	173.9	556.7	161.7	51.4	37.5	586.3
28	3.779	52.56	309.9	173.9	556.9	161.7	51.5	37.7	587.9
29	3.915	50.72	309.9	173.9	556.7	161.9	51.5	37.7	587.3
30	3.721	53.41	309.9	173.9	556.2	162.2	51.5	37.8	586.3
31	3.878	51.20	309.9	173.9	556.1	162.3	51.6	37.9	587.7
32	3.824	51.93	309.8	173.9	556.5	162.4	51.7	37.9	586.7
Avg.:	3.816	52.05	309.9	173.9	557.0	155.3	50.9	36.7	587.0
Min:	3.712	49.94	309.7	173.8	556.1	143.5	50.2	35.9	586.1
Max:	3.977	53.54	310.0	174.0	557.8	162.4	51.7	37.9	587.9
Range:	0.264	3.60	0.2	0.1	1.6	18.9	1.5	2.0	1.8
Std. Dev.:	0.061	0.84	0.1	0.0	0.4	6.8	0.4	0.6	0.5

IQT™ Results - Run Details

Run ID: 910
Fuel ID: CL08-00108
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 12:25:21 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	4.190	47.48	309.8	175.1	557.6	140.8	50.2	35.8	587.1
2	4.218	47.17	309.7	175.2	558.0	140.6	50.1	35.7	587.9
3	4.106	48.41	309.8	175.2	557.4	140.7	50.1	35.6	587.2
4	4.094	48.55	309.8	175.1	558.1	141.2	49.9	35.5	588.7
5	4.170	47.69	309.9	175.2	558.5	141.3	49.9	35.4	587.9
6	4.062	48.91	309.9	175.2	557.8	142.0	49.6	35.2	587.3
7	4.047	49.09	310.0	175.2	558.1	142.5	49.6	35.2	588.4
8	4.067	48.85	309.9	175.2	558.2	142.7	49.5	35.2	587.2
9	3.968	50.04	309.9	175.2	558.0	143.5	49.5	35.0	588.4
10	4.094	48.54	309.9	175.2	558.4	145.5	49.5	35.0	588.1
11	4.116	48.29	309.9	175.1	558.1	147.6	49.4	34.9	587.4
12	4.237	46.98	309.8	175.1	557.7	149.2	49.5	34.8	588.0
13	4.035	49.23	309.8	175.2	557.8	150.9	49.4	34.9	588.0
14	4.349	45.84	309.7	175.1	557.8	152.2	49.5	35.1	588.1
15	4.084	48.66	309.7	175.1	557.4	153.4	49.4	35.1	587.3
16	3.951	50.26	309.7	175.1	557.6	154.4	49.6	35.3	588.2
17	4.044	49.13	309.7	175.1	557.6	155.4	49.6	35.5	587.2
18	3.849	51.60	309.7	175.1	557.8	156.2	49.8	35.4	588.5
19	3.996	49.70	309.6	175.1	557.7	156.9	50.0	35.6	587.5
20	3.933	50.49	309.7	175.1	557.0	157.6	50.0	35.7	587.4
21	4.061	48.93	309.7	175.1	557.1	158.3	50.1	35.9	587.8
22	4.085	48.64	309.7	175.1	557.0	158.6	50.4	36.0	587.2
23	4.063	48.90	309.7	175.1	557.3	159.1	50.3	36.2	587.7
24	4.078	48.72	309.8	175.1	557.1	159.4	50.5	36.4	587.0
25	4.074	48.78	309.7	175.1	557.3	158.2	50.6	36.5	588.7
26	4.024	49.36	309.8	175.1	557.5	156.9	50.7	36.7	588.3
27	4.090	48.59	309.7	175.1	557.3	155.4	50.7	36.7	586.4
28	4.010	49.54	309.8	175.2	557.0	153.6	50.8	36.8	587.9
29	4.088	48.61	309.8	175.1	557.1	151.8	50.8	36.8	587.3
30	4.036	49.22	309.6	175.2	556.8	151.0	50.7	36.8	588.6
31	4.016	49.46	309.7	175.2	557.2	150.2	50.9	36.9	587.6
32	4.094	48.54	309.8	175.2	557.2	149.2	50.9	36.8	587.5
Avg.:	4.073	48.79	309.8	175.1	557.6	150.5	50.0	35.8	587.7
Min:	3.849	45.84	309.6	175.1	556.8	140.6	49.4	34.8	586.4
Max:	4.349	51.60	310.0	175.2	558.5	159.4	50.9	36.9	588.7
Range:	0.501	5.76	0.4	0.2	1.7	18.7	1.5	2.1	2.3
Std. Dev.:	0.093	1.07	0.1	0.0	0.4	6.6	0.5	0.7	0.6

IQT™ Results - Run Details

Run ID: 913
Fuel ID: CL08-00109
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/8/2008 1:38:00 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	4.199	47.38	309.6	175.1	556.1	150.2	50.6	36.5	587.5	
2	3.967	50.06	309.7	175.1	556.6	149.4	50.6	36.5	587.0	
3	4.116	48.29	309.7	175.0	556.0	148.7	50.6	36.5	587.3	
4	4.005	49.59	309.7	175.1	556.5	148.1	50.5	36.3	587.8	
5	4.216	47.19	309.8	175.1	556.2	147.4	50.5	36.4	586.4	
6	4.053	49.02	309.7	175.1	556.7	146.8	50.5	36.3	587.9	
7	4.109	48.38	309.8	175.1	556.8	146.6	50.5	36.3	586.8	
8	4.021	49.40	309.7	175.1	556.9	145.8	50.5	36.2	588.3	
9	4.163	47.76	309.6	175.1	557.1	145.1	50.4	36.1	587.6	
10	4.226	47.09	309.6	175.1	556.8	144.9	50.3	36.1	586.8	
11	4.021	49.40	309.7	175.1	557.0	144.9	50.4	35.9	588.3	
12	4.104	48.43	309.7	175.1	557.1	145.0	50.2	35.9	587.3	
13	3.999	49.66	309.8	175.1	556.9	145.4	50.2	35.8	587.5	
14	4.094	48.54	309.7	175.1	557.3	145.4	50.0	35.6	587.4	
15	4.201	47.35	309.7	175.1	557.1	145.1	50.0	35.6	587.5	
16	4.168	47.71	309.7	175.2	557.1	145.3	49.9	35.6	587.3	
17	4.086	48.64	309.7	175.1	557.2	145.2	49.8	35.4	587.5	
18	4.160	47.81	309.8	175.1	557.1	144.6	49.7	35.3	587.5	
19	4.071	48.81	309.9	175.2	557.2	144.4	49.8	35.2	588.6	
20	4.180	47.58	310.0	175.2	557.4	144.3	49.6	35.1	587.6	
21	4.063	48.90	309.9	175.2	557.3	145.5	49.5	35.0	587.9	
22	4.182	47.56	309.9	175.1	557.7	147.6	49.5	35.0	588.3	
23	4.238	46.96	309.8	175.1	557.1	149.4	49.4	34.9	587.6	
24	4.085	48.64	309.8	175.1	557.4	150.9	49.3	34.9	589.1	
25	4.169	47.70	309.8	175.1	557.4	152.3	49.4	34.9	588.0	
26	3.987	49.81	309.8	175.1	557.0	153.4	49.5	34.9	587.4	
27	3.976	49.95	309.7	175.1	557.4	154.2	49.5	35.1	588.2	
28	3.987	49.82	309.7	175.1	557.0	154.7	49.5	35.3	587.0	
29	4.046	49.10	309.7	175.1	557.1	155.5	49.6	35.3	588.7	
30	4.086	48.64	309.7	175.1	557.2	156.3	49.7	35.3	587.7	
31	3.972	50.00	309.7	175.1	556.7	156.9	49.8	35.6	587.1	
32	4.099	48.48	309.6	175.1	556.6	157.7	50.1	35.7	587.8	
Avg.:	4.095	48.53	309.7	175.1	557.0	148.7	50.0	35.6	587.6	
Min:	3.967	46.96	309.6	175.0	556.0	144.3	49.3	34.9	586.4	
Max:	4.238	50.06	310.0	175.2	557.7	157.7	50.6	36.5	589.1	
Range:	0.271	3.10	0.3	0.2	1.7	13.4	1.3	1.7	2.7	
Std. Dev.:	0.083	0.95	0.1	0.0	0.4	4.2	0.4	0.6	0.6	

IQT™ Results - Run Details

Run ID: 928
Fuel ID: CL08-00110
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 11:20:36 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.196	63.16	309.8	174.1	556.7	158.5	51.0	37.1	586.0
2	3.164	63.92	310.0	174.1	556.7	158.9	51.3	37.2	587.3
3	3.224	62.50	309.9	174.1	556.5	159.4	51.3	37.3	586.2
4	3.124	64.89	309.8	174.1	556.1	159.9	51.4	37.3	587.5
5	3.241	62.13	309.9	174.1	556.6	160.3	51.3	37.4	586.8
6	3.197	63.14	309.9	174.1	556.4	160.6	51.5	37.5	587.0
7	3.168	63.82	309.9	174.1	556.6	160.8	51.5	37.6	586.9
8	3.119	65.02	309.9	174.1	556.4	161.1	51.6	37.6	586.4
9	3.215	62.72	309.9	174.1	556.6	160.3	51.7	37.7	587.3
10	3.196	63.16	309.9	174.1	556.6	158.7	51.7	37.8	586.0
11	3.222	62.56	309.9	174.2	556.1	157.3	51.8	37.9	587.2
12	3.260	61.71	309.9	174.2	556.3	155.3	51.7	37.9	586.5
13	3.164	63.91	310.0	174.2	556.4	154.3	51.7	37.9	587.3
14	3.265	61.60	309.9	174.2	556.7	152.7	51.7	37.9	586.8
15	3.181	63.50	310.0	174.2	556.3	152.2	51.6	37.8	587.2
16	3.188	63.33	310.0	174.3	556.9	151.5	51.6	37.7	587.4
17	3.175	63.64	310.0	174.3	556.6	151.0	51.6	37.6	587.0
18	3.112	65.20	310.0	174.2	556.9	150.4	51.6	37.5	587.3
19	3.213	62.77	310.1	174.3	556.8	150.0	51.5	37.3	587.3
20	3.083	65.95	310.0	174.3	557.0	149.0	51.4	37.2	587.5
21	3.179	63.56	310.0	174.3	556.7	148.4	51.3	37.1	586.7
22	3.183	63.46	309.9	174.3	556.9	147.7	51.2	37.0	587.7
23	3.232	62.33	309.9	174.3	556.9	147.3	51.0	36.8	587.2
24	3.158	64.07	309.9	174.3	557.2	147.2	50.9	36.7	587.9
25	3.105	65.39	309.8	174.3	557.3	147.1	50.8	36.6	587.4
26	3.129	64.77	310.0	174.3	557.1	146.9	50.7	36.4	587.9
27	3.093	65.68	309.8	174.3	557.5	147.6	50.8	36.3	587.9
28	3.112	65.18	309.8	174.3	557.4	149.3	50.6	36.2	587.7
29	3.207	62.90	309.8	174.3	557.3	151.1	50.5	36.1	587.6
30	3.102	65.45	309.8	174.2	556.9	152.8	50.5	36.1	588.2
31	3.171	63.74	309.8	174.3	557.8	154.0	50.4	36.1	588.0
32	3.134	64.63	309.9	174.3	557.2	155.1	50.4	36.1	587.1
Avg.:	3.172	63.72	309.9	174.2	556.8	153.6	51.2	37.1	587.2
Min:	3.083	61.60	309.8	174.1	556.1	146.9	50.4	36.1	586.0
Max:	3.265	65.95	310.1	174.3	557.8	161.1	51.8	37.9	588.2
Range:	0.182	4.35	0.3	0.3	1.6	14.1	1.3	1.8	2.2
Std. Dev.:	0.050	1.19	0.1	0.1	0.4	5.0	0.4	0.6	0.6

IQT™ Results - Run Details

Run ID: 934
Fuel ID: CL08-00111
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 1:50:55 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	3.541	56.27	309.7	175.5	557.1	151.7	50.0	35.6	588.3
2	3.651	54.48	309.6	175.5	557.2	153.2	50.0	35.7	587.7
3	3.496	57.07	309.7	175.5	556.9	154.4	50.1	35.7	586.6
4	3.611	55.11	309.7	175.5	556.7	155.6	50.1	35.8	587.7
5	3.700	53.73	309.8	175.5	556.8	156.6	50.2	35.9	586.9
6	3.590	55.45	309.8	175.5	557.0	157.4	50.2	36.1	587.7
7	3.621	54.95	309.8	175.5	556.8	158.0	50.3	36.2	586.8
8	3.598	55.33	309.8	175.5	556.7	158.7	50.3	36.3	587.5
9	3.560	55.95	309.9	175.5	557.0	159.3	50.5	36.4	587.1
10	3.728	53.30	310.0	175.5	556.7	159.7	50.5	36.4	586.8
11	3.517	56.70	309.9	175.5	557.0	160.4	50.7	36.5	587.6
12	3.675	54.11	310.0	175.5	556.6	160.9	50.7	36.8	586.3
13	3.564	55.88	309.9	175.5	556.8	161.3	50.9	36.8	587.7
14	3.578	55.66	310.0	175.5	557.1	161.6	51.0	37.0	587.4
15	3.668	54.22	310.0	175.5	556.3	161.8	51.0	37.0	586.2
16	3.593	55.41	310.0	175.5	556.8	161.3	51.1	37.2	587.4
17	3.700	53.72	309.9	175.5	556.6	159.5	51.2	37.3	586.2
18	3.808	52.16	310.0	175.6	556.8	157.5	51.4	37.4	587.1
19	3.653	54.45	309.9	175.5	556.8	156.5	51.4	37.5	586.7
20	3.590	55.45	309.9	175.5	556.3	155.5	51.5	37.6	587.2
21	3.779	52.56	309.9	175.6	556.5	154.2	51.4	37.6	587.2
22	3.604	55.23	310.0	175.6	556.4	152.9	51.4	37.4	587.2
23	3.739	53.14	309.9	175.5	556.6	151.6	51.5	37.5	587.6
24	3.520	56.64	309.9	175.5	556.3	150.9	51.4	37.4	587.2
25	3.650	54.48	310.0	175.6	556.7	150.0	51.3	37.3	587.5
26	3.686	53.93	309.9	175.6	556.8	149.9	51.2	37.2	587.7
27	3.509	56.82	309.9	175.6	557.2	149.1	51.2	37.0	587.6
28	3.645	54.57	309.8	175.6	556.6	148.2	51.0	37.0	586.9
29	3.712	53.54	309.7	175.6	556.5	148.3	51.0	36.9	588.2
30	3.703	53.68	309.7	175.6	556.8	148.2	50.8	36.8	587.3
31	3.675	54.11	309.7	175.6	557.0	147.8	50.8	36.7	588.4
32	3.690	53.87	309.7	175.6	556.5	147.6	50.7	36.6	587.3
Avg.:	3.636	54.71	309.9	175.5	556.7	155.0	50.8	36.8	587.3
Min:	3.496	52.16	309.6	175.5	556.3	147.6	50.0	35.6	586.2
Max:	3.808	57.07	310.0	175.6	557.2	161.8	51.5	37.6	588.4
Range:	0.312	4.91	0.4	0.2	1.0	14.2	1.5	1.9	2.2
Std. Dev.:	0.079	1.25	0.1	0.0	0.3	4.8	0.5	0.6	0.6

IQT™ Results - Run Details

Run ID: 929
Fuel ID: CL08-00112
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 11:42:48 AM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.
1	2.987	68.58	309.9	174.4	556.8	144.6	50.9	36.7	587.2
2	3.028	67.41	309.9	174.4	556.5	144.5	50.8	36.7	586.6
3	2.962	69.33	309.9	174.5	556.9	144.2	50.7	36.4	587.9
4	3.046	66.92	309.9	174.4	556.9	143.9	50.7	36.4	586.5
5	3.013	67.85	309.9	174.4	557.1	143.7	50.6	36.3	587.2
6	2.910	70.93	309.8	174.5	556.9	143.9	50.5	36.3	587.3
7	2.917	70.68	309.8	174.5	557.1	143.6	50.5	36.0	587.1
8	2.998	68.27	309.7	174.5	557.5	144.0	50.3	35.9	588.1
9	2.977	68.88	309.8	174.4	557.2	145.4	50.3	35.8	586.5
10	3.049	66.84	309.7	174.4	557.4	147.4	50.1	35.7	587.4
11	3.041	67.07	309.8	174.4	557.4	149.5	50.1	35.7	587.1
12	3.026	67.48	309.8	174.4	557.5	151.2	50.1	35.6	588.4
13	2.991	68.47	309.8	174.4	557.6	152.8	50.2	35.7	587.7
14	2.988	68.56	309.7	174.4	557.0	154.2	50.1	35.7	586.8
15	2.957	69.46	309.8	174.4	557.6	155.2	50.2	35.8	587.4
16	2.990	68.49	309.8	174.4	556.9	156.1	50.2	35.9	586.9
17	2.983	68.71	309.8	174.4	556.9	157.1	50.2	35.9	588.3
18	3.041	67.06	309.9	174.4	556.7	157.6	50.3	36.1	587.4
19	3.035	67.22	309.9	174.4	556.5	158.2	50.4	36.2	587.3
20	3.004	68.10	309.9	174.4	556.9	158.8	50.5	36.4	587.4
21	3.052	66.76	309.9	174.4	556.5	159.2	50.5	36.4	586.9
22	2.997	68.30	309.8	174.4	556.9	159.7	50.6	36.5	587.3
23	3.093	65.68	309.9	174.4	556.7	160.0	50.8	36.7	587.4
24	3.037	67.18	309.9	174.4	557.1	160.3	50.7	36.7	588.1
25	3.065	66.41	310.0	174.4	556.8	160.5	50.9	36.9	586.4
26	2.985	68.64	309.9	174.4	556.6	160.6	51.0	37.0	587.4
27	3.064	66.45	309.9	174.4	556.7	160.7	51.1	37.1	586.8
28	2.990	68.48	310.0	174.4	556.4	160.9	51.2	37.2	587.4
29	3.048	66.88	309.9	174.4	556.9	161.0	51.1	37.3	587.5
30	2.969	69.12	310.0	174.4	556.4	161.0	51.4	37.4	586.3
31	2.969	69.12	309.9	174.4	556.7	160.5	51.4	37.5	587.6
32	3.053	66.75	309.9	174.4	556.6	158.5	51.5	37.6	586.2
Avg.:	3.008	67.97	309.9	174.4	556.9	153.7	50.6	36.4	587.2
Min:	2.910	65.68	309.7	174.4	556.4	143.6	50.1	35.6	586.2
Max:	3.093	70.93	310.0	174.5	557.6	161.0	51.5	37.6	588.4
Range:	0.183	5.25	0.3	0.1	1.2	17.5	1.4	2.0	2.2
Std. Dev.:	0.043	1.22	0.1	0.0	0.4	6.9	0.4	0.6	0.6

IQT™ Results - Run Details

Run ID: 930
Fuel ID: CL08-00113
ISS version: 3.40a, rev. 12a
Test Method: ASTM D6890-04

Date & Time: 4/9/2008 12:05:54 PM
Operator: SA
Setpoint: 580.0
S/W License Code: 98EF-7334

Inj. #	ID	DCN	Charge P.	Inj. P.	Test T.	Trans. T.	Nozzle T.	Coolant T.	Air B. T.	
1	3.169	63.79	309.8	174.5	556.3	157.2	50.9	37.0	586.6	
2	3.279	61.30	309.9	174.5	555.8	157.8	51.0	37.1	586.2	
3	3.214	62.73	309.9	174.5	555.8	158.4	51.1	37.2	587.1	
4	3.189	63.31	309.9	174.5	555.8	158.8	51.3	37.4	586.2	
5	3.254	61.83	310.0	174.5	556.3	159.2	51.3	37.4	587.5	
6	3.200	63.05	310.0	174.5	556.4	159.6	51.5	37.5	586.5	
7	3.167	63.83	309.8	174.5	555.8	159.8	51.6	37.6	586.5	
8	3.224	62.52	309.9	174.5	556.3	158.5	51.6	37.7	586.9	
9	3.221	62.58	310.0	174.6	556.2	156.3	51.6	37.8	585.8	
10	3.188	63.33	310.0	174.5	556.1	154.8	51.8	37.9	587.4	
11	3.270	61.49	310.0	174.6	555.9	153.8	51.7	37.9	586.3	
12	3.215	62.72	310.0	174.6	555.9	152.3	51.7	37.8	586.9	
13	3.229	62.39	310.0	174.6	556.2	151.5	51.6	37.9	586.7	
14	3.321	60.41	309.9	174.6	556.2	150.3	51.5	37.8	587.7	
15	3.259	61.72	309.9	174.6	556.2	149.0	51.6	37.7	586.9	
16	3.223	62.54	309.9	174.6	556.3	148.2	51.5	37.6	587.1	
17	3.226	62.47	309.9	174.7	556.2	148.1	51.4	37.5	587.1	
18	3.222	62.56	309.8	174.7	556.2	147.4	51.3	37.4	587.8	
19	3.186	63.39	309.9	174.7	556.5	147.5	51.3	37.3	587.6	
20	3.182	63.47	309.9	174.7	556.1	147.0	51.2	37.2	586.7	
21	3.182	63.49	309.8	174.7	556.4	147.0	51.1	37.0	587.9	
22	3.132	64.68	309.8	174.7	556.7	146.5	51.0	36.9	587.7	
23	3.161	63.98	309.8	174.7	556.7	146.1	50.8	36.7	588.1	
24	3.249	61.96	309.9	174.7	556.9	145.5	50.8	36.7	587.6	
25	3.202	63.01	309.6	174.7	556.7	146.1	50.6	36.6	587.8	
26	3.160	64.01	309.7	174.7	557.2	146.5	50.6	36.5	588.0	
27	3.225	62.49	309.7	174.7	556.9	146.2	50.5	36.3	587.0	
28	3.219	62.62	309.7	174.8	556.8	145.7	50.5	36.2	588.0	
29	3.247	62.00	309.7	174.7	556.9	145.5	50.3	36.1	587.4	
30	3.314	60.55	309.7	174.7	557.1	145.8	50.2	35.9	588.2	
31	3.263	61.64	309.7	174.7	557.0	146.8	50.2	35.7	587.1	
32	3.198	63.10	309.5	174.6	557.1	148.9	50.1	35.7	588.3	
Avg.:	3.218	62.64	309.8	174.6	556.4	151.0	51.1	37.1	587.2	
Min:	3.132	60.41	309.5	174.5	555.8	145.5	50.1	35.7	585.8	
Max:	3.321	64.68	310.0	174.8	557.2	159.8	51.8	37.9	588.3	
Range:	0.189	4.28	0.5	0.3	1.4	14.3	1.7	2.2	2.4	
Std. Dev.:	0.043	0.98	0.1	0.1	0.4	5.2	0.5	0.7	0.7	

APPENDIX – II

[redacted]

National Biofuels Energy Lab

WAYNE STATE UNIVERSITY COLLEGE OF ENGINEERING

[redacted]

Measurement of Derived Cetane Numbers of SWRI Samples

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August 13, 2008

Approved by

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WAYNE STATE UNIVERSITY COLLEGE OF ENGINEERING

Summary

National Biofuels Energy Laboratory (NBEL) was contracted to complete Derived Cetane Number (DCN) testing of 22 fuel samples, which consisted of a mix of 13 jet aviation fuel samples, 4 synthetic jet fuel samples, 4 ULSD samples and 1 biodiesel sample for the Southwest Research Institute (SWRI). The testing was completed on an Ignition Quality Tester (IQT™) from Advanced Engine Technology Ltd. located at NBEL. The IQT™ utilizes the ASTM D6890-7b testing method to measure the ignition delay (ID) of the fuel sample using a position sensor (opening of the fuel injector) and a pressure sensor (rapid rise of chamber pressure due to fuel combustion). A picture of the instrument and a typical combustion pressure and injector needle lift curves as a function of time are given in Figure 1. For ID between 3.3 and 6.4 ms the DCN is calculated within the IQT™ software utilizing the following derived equation:

$$DCN = 4.46 + (186.6/ID) \qquad \text{Eq. 1}[1]$$

Outside this range the following correlation equation is used.

$$DCN_{IQT} = 83.99 \times (ID - 1.512)^{-0.658} + 3.547 \qquad \text{Eq. 2}[1]$$

The IQT™ testing procedure consists of 15 non-recorded pre-injections and then 32 recorded injections. The average ID and DCN of the 32 recorded injections are then tabulated along with their subsequent standard deviations.

Testing Procedure

To ensure that the proper measurements were obtained, the IQT™ was calibrated before each days run with heptane with a minimum purity of 99.5% expected ID of 3.78 ± .06 ms. The heptane was initially ran three times, and if the three runs fell within the expected ID range, the fuel samples were then tested. If the three runs were out of the range, the IQT™ was properly calibrated using the procedures manual, and the heptane was then retested to ensure that the ID fell within the expected range. Each fuel was filtered with a 25 mm diameter filter with a pore size of 5 µm in accordance with ASTM D6890-7b. Four runs for each fuel sample were tested to get an average ID and DCN.

The results were all tabulated and can be seen in Table 1. Graphs of both the ID and DCN for all the fuel samples were generated with the Standard Deviation error bars for this summary report and can be seen in Figures 2 & 3.

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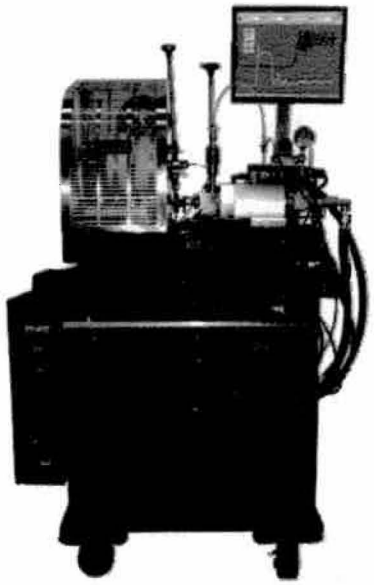
[1] "AET Procedures Manual: Ignition Quality Tester (IQT™) for Diesel Fuel Cetane Number Evaluation" Advanced Engine Technology Ltd., Nepean, Ontario, 2007.

Figure 1: (a) A picture of IQT™ (b) Pressure and Injector needle lift traces for a single combustion event

1a



1b

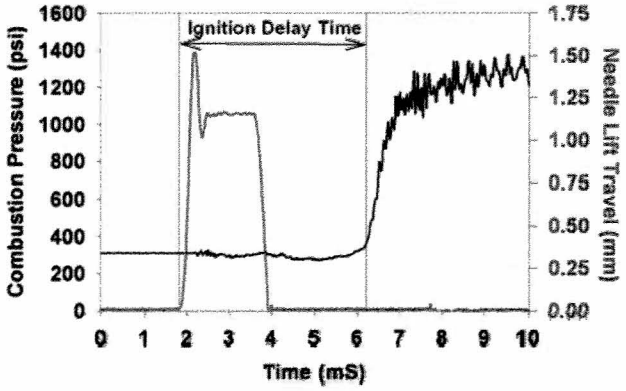


Table 1 – SWRI Tabulated ID and DCN Results

Fuel Name	Avg ID	Std Dev ID	Avg DCN	Std Dev DCN	Avg ID	Std Dev ID	Avg DCN	Std Dev DCN
CL08-00092	4.82	0.091	43.17	0.74	4.79	0.053	43.43	0.43
	4.711	0.118	44.07	1.01				
	4.803	0.089	43.31	0.73				
	4.822	0.068	43.16	0.55				
CL08-00093	3.632	0.068	55.83	0.97	3.59	0.093	56.46	1.37
	3.681	0.066	55.15	0.92				
	3.585	0.07	56.51	1.02				
	3.463	0.086	58.34	1.35				
CL08-00094	2.815	0.063	70.75	1.47	2.77	0.041	71.78	1.01
	2.79	0.071	71.34	1.71				
	2.767	0.054	71.9	1.3				
	2.718	0.066	73.11	1.7				
CL08-00095	3.453	0.143	58.49	2.21	3.51	0.046	57.58	0.70
	3.504	0.12	57.72	1.85				
	3.56	0.155	56.88	2.32				
	3.536	0.143	57.24	2.15				
CL08-00096	3.628	0.06	55.9	0.85	3.71	0.076	54.73	1.04
	3.676	0.061	55.22	0.84				
	3.748	0.058	54.24	0.78				
	3.8	0.067	53.56	0.86				
CL08-00097	4.439	0.088	46.49	0.84	4.39	0.046	46.94	0.45
	4.427	0.13	46.61	1.3				
	4.35	0.14	47.36	1.44				
	4.358	0.082	47.28	0.81				
CL08-00098	3.744	0.106	54.29	1.47	3.75	0.023	54.27	0.31
	3.746	0.06	54.27	0.81				
	3.776	0.093	53.88	1.2				
	3.719	0.095	54.64	1.32				
CL08-00099	4.35	0.092	47.35	0.92	4.41	0.042	46.74	0.41
	4.434	0.059	46.54	0.57				
	4.43	0.068	46.58	0.65				
	4.439	0.064	46.5	0.6				
CL08-00100	3.906	0.078	52.24	0.96	3.86	0.045	52.79	0.57
	3.882	0.07	52.53	0.86				
	3.8	0.144	53.56	1.97				
	3.857	0.063	52.84	0.79				
CL08-00101	4.003	0.099	51.08	1.14	3.98	0.032	51.41	0.38
	3.982	0.078	51.32	0.93				
	3.986	0.09	51.27	1.06				
	3.929	0.096	51.95	1.15				
CL08-00102	3.23	0.042	62.23	0.76	3.25	0.011	61.96	0.19
	3.249	0.067	61.88	1.2				
	3.247	0.057	61.93	0.99				
	3.256	0.07	61.78	1.24				
CL08-00103	3.769	0.084	53.97	1.12	3.75	0.067	54.29	0.91
	3.793	0.091	53.66	1.18				
	3.646	0.206	55.64	3.06				
	3.774	0.069	53.9	0.9				
CL08-00104	3.61	0.101	56.15	1.49	3.60	0.010	56.31	0.14
	3.604	0.09	56.24	1.33				
	3.592	0.095	56.4	1.39				
	3.589	0.098	56.45	1.42				
CL08-00105	3.707	0.121	54.79	1.72	3.74	0.027	54.35	0.36
	3.742	0.096	54.32	1.31				
	3.739	0.082	54.37	1.1				
	3.773	0.099	53.92	1.32				
CL08-00106	3.549	0.112	57.04	1.68	3.56	0.018	56.95	0.27
	3.546	0.096	57.08	1.44				
	3.582	0.122	56.55	1.82				
	3.543	0.108	57.12	1.62				
CL08-00107	3.906	0.078	52.23	0.94	3.91	0.005	52.24	0.07
	3.904	0.066	52.25	0.81				
	3.899	0.083	52.32	1				
	3.912	0.088	52.16	1.06				
CL08-00108	4.205	0.093	48.84	0.99	4.19	0.043	48.97	0.46
	4.237	0.096	48.5	1.01				
	4.195	0.134	48.94	1.46				
	4.135	0.15	49.59	1.72				
CL08-00109	3.974	0.08	51.42	0.95	3.97	0.054	51.42	0.63
	4.041	0.075	50.64	0.86				
	3.909	0.196	52.19	2.76				
	3.973	0.101	51.43	1.2				
CL08-00110	3.172	0.052	63.29	0.96	3.16	0.013	63.50	0.24
	3.153	0.062	63.64	1.16				
	3.171	0.065	63.31	1.2				
	3.146	0.067	63.77	1.26				
CL08-00111	3.615	0.085	56.07	1.23	3.62	0.021	56.04	0.30
	3.639	0.105	55.74	1.5				
	3.627	0.102	55.91	1.51				
	3.589	0.079	56.45	1.14				
CL08-00112	3.073	0.071	65.17	1.47	3.11	0.029	64.47	0.57
	3.112	0.089	64.43	1.87				
	3.108	0.068	64.5	1.31				
	3.145	0.073	63.78	1.43				
CL08-00113	3.388	0.054	59.53	0.88	3.39	0.020	59.52	0.32
	3.392	0.055	59.48	0.89				
	3.413	0.074	59.13	1.19				
	3.365	0.057	59.92	0.94				

Figure 2 – SWRI ID Graph

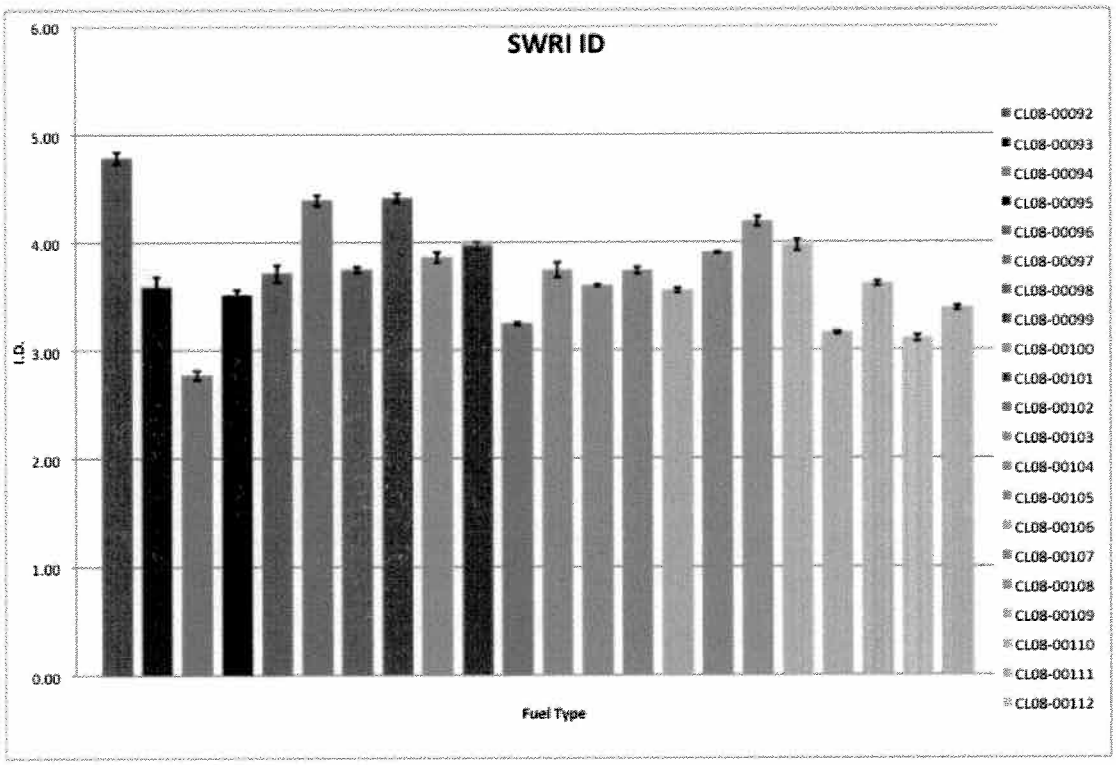


Figure 3 – SWRI DCN Graph